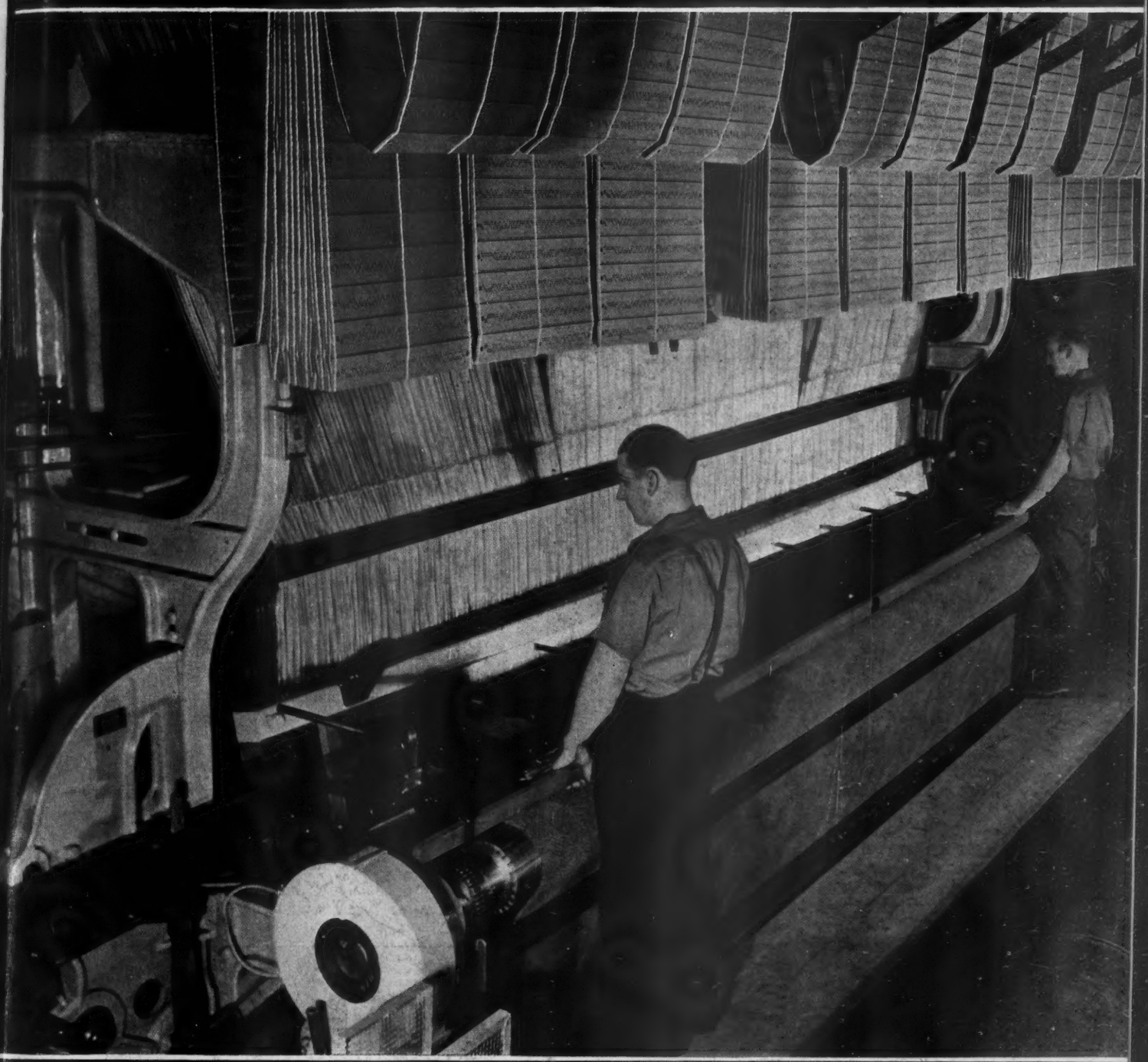
SEPTEMBER, 1940

FACTORY

MANAGEMENT and MAINTENANCE

A McGRAW-HILL PUBLICATION



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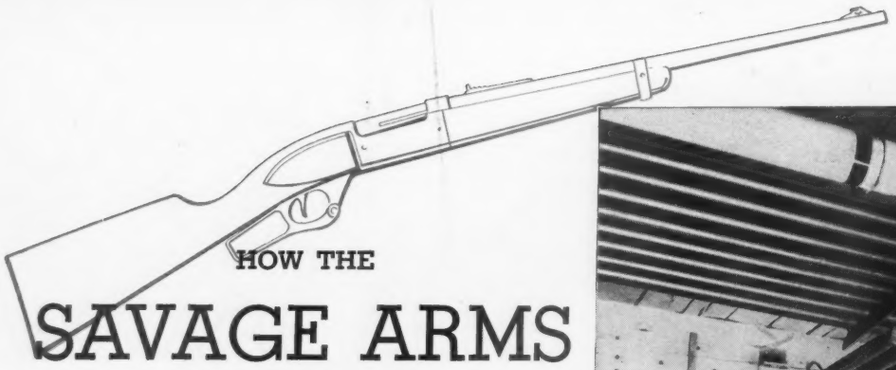


HOW THE

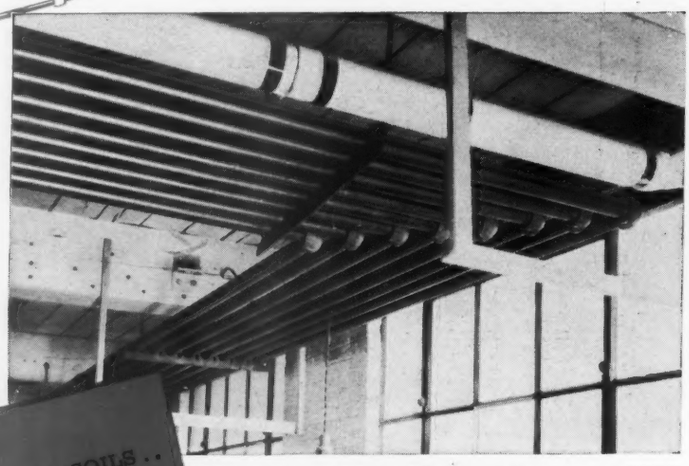
SAVAGE ARMS

CORPORATION

HANDLES MAINTENANCE

PROBLEMS IN THESE

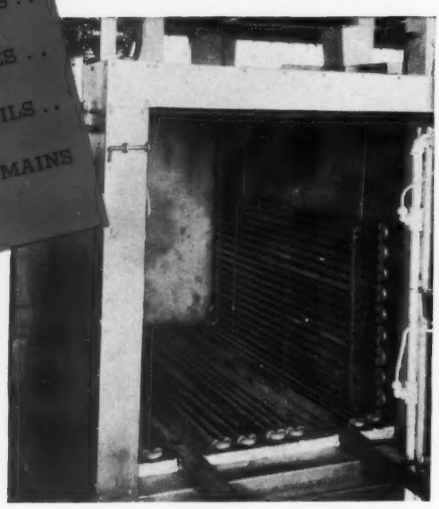
CORROSIVE SERVICES . . .



Overhead Heating Coil in Carpenter Shop; Byers Wrought Iron

- DRYER HEATING COILS . .
- STEAM SUPPLY LINES . .
- STEAM RETURN LINES . .
- STEAM HEATING COILS . .
- FIRE PROTECTION MAINS

BYERS WROUGHT IRON



Heating Coils in Drying Cabinet, Refrigeration Dept.; Byers Wrought Iron

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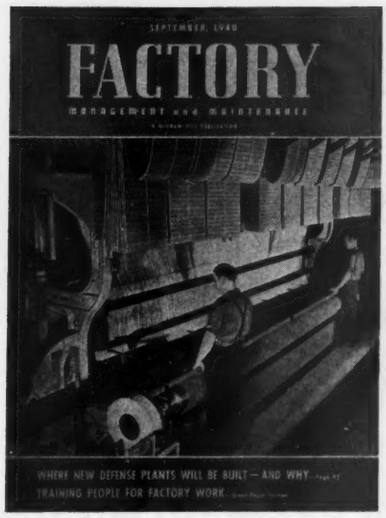
STEEL TUBULAR PRODUCTS



Carpet looms don't come much bigger than the one on this month's cover. FACTORY's editors spotted it at Bigelow-Sanford Company, which has two more like it in its sprawling mills at Thompsonville, Conn. A Jacquard Wilton loom, it weaves seamless carpeting 15 feet wide. The grayish "cards" in upper part of the picture govern movement of an overhead mechanism from which cords control the yarn ends and select right color to form the pattern. Kodachrome by McGraw-Hill photographic department.

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G. A. VAN BRUNT, LEWIS K. URQUHART
Associate Editors

J. F. ANDREWS, CHARLES B. COATES
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A. H. MOGENSEN, ARTHUR VAN VLISSINGEN, WHITING WILLIAMS
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H. P. DUTTON, *Chicago*; C. B. GORDY, *Detroit*; PAUL WOOTON, *Washington*

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FACTORY

MANAGEMENT and MAINTENANCE

SEPTEMBER, 1940

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FACTORY
MANAGEMENT and MAINTENANCE
L. C. MORROW, Editor

Watch These Defense Bottlenecks

I HAVE BEEN TRYING to look ahead for bottlenecks in America's defense work. And I have attempted to classify them as bottlenecks about which industry can do something, or nothing.

The principal bottleneck is lack of provision for defense-plant amortization. Delay in setting depreciation rates is due to administration insistence on tying up amortization and excess profits tax provisions in the same legislation. It would be fine if industry could begin its expansion under a full set of rules. But to decide what are excess profits and how they shall be taxed is a complicated problem. Time is required. Therefore amortization should be treated separately and depreciation rates set at once. Because rates have not been set, the entire defense program is being held up. The situation is inexcusable. It is one about which industry can do nothing except to urge speedy action by Congress.

Bottleneck next in importance is the lack of trained workers. Once defense production really gets under way, this lack will be felt seriously. Not only will industry need many more trained workers; so will the army. Modern armies are mechanized armies. They require mechanics. It is a safe bet that some of the skilled workers of industry will be drafted for army work, with industry forced to assume the burden of training replacements. Here is a bottleneck that industry can do something about—as it has in the state of Connecticut, in the city of Cleveland, and in other localities, with gratifying results.

Strikes may constitute another bottleneck. It is likely that Washington, in the person of Sidney Hillman, of the Defense Advisory Commission, will frown upon strikes by well-paid workers whose principal objective is "getting theirs" while plants are busy; also upon strikes resulting from grievances that can be settled by bargaining or conciliation. But if the price situation gets out of hand, and the cost of living goes up without commensurate increases in wages, strikes will come. Here is a serious potential bottleneck about which industry can do something and concerning which it should be watchful.

Still another bottleneck is likely to lie in plant construction. Once the amortization question is settled, there will be a rush for the services of designers and builders of industrial plants. Construction forces will be in great demand. Again industry can do something, by having its plans made, its sites selected, and its equipment determined in advance of the go-ahead signal.

These are the bottlenecks that I think I can see for the near future. There will be others, but it looks as though the ones mentioned should receive the lion's share of industry's attention right now.

L. C. Morrow

Where New Defense Plants

First consideration is maximum production. Existing plants aren't likely to move. Industry may select its own sites for factories that are privately financed. *But when government supplies the funds it will build "inside the mountains" to reduce the hazard of air attacks*

MAJOR ROBERT GINSBURGH
U. S. Army

Widespread public controversy now surrounds the selection of plant sites in the new national defense program. Much confusion has been caused by political maneuvering and demands of rival pressure groups.

What are the facts? What is the attitude of the military authorities who have so long studied the problems of industrial mobilization? The correct location of defense production facilities is a question of great significance to industry and the nation.

To get the facts, FACTORY *went directly to the office of the Assistant Secretary of War, the agency charged with the long-range planning of the industrial effort. The accompanying article, by an officer of that department, makes clear the policy that will govern the location of government-financed munitions plants in sites which are best adapted geographically to effective national defense.*—THE EDITOR

FOR GOD'S SAKE, move inside the mountains! The air hazard is becoming more acute every day. Every time I sign a War Department contract, I feel like adding these words as a postscript."

The evening newspapers of Chicago printed this quotation as part of an interview with the Assistant Secretary of War, Louis Johnson, in that city on March 1, 1939. The next morning the story appeared throughout the country. It was repeated over the air. Reaction was immediate. Twenty-four hours later, the War Department was buried under an avalanche of telegrams and air mail letters—protests from chambers of commerce in seacoast cities, pleas from boards of trade in inland towns. Along the Atlantic and Pacific coasts they complained that such remarks wreck confidence, destroy real estate values, undermine business, and create grave unrest among the population.

"Why do we have an army, anyway," they asked "if not to protect our coastal cities?"

The communications from the interior came in an entirely different vein.

"We have the power, the transportation, the facilities," they pleaded; "why not build a factory in our town?"

Some begged. Some cajoled. Some appealed to their congressmen. Some sent committees to Washington. A few claimed a factory site should be awarded to them as a matter of right.

The remarks of the Assistant Secretary of War, of course, were merely suggestive; and, let it be noted, they were made six months before the invasion of Poland. At that time, the air menace to industrial centers was still a subject for academic discussion. The Polish industrial triangle, the great factory cities of Holland, Belgium, and France still stood firm. The prospect of punitive flights against the munitions centers of England seemed imaginary.

No Wholesale Migration

The danger of our own seacoast cities to attack from the air at some tomorrow no longer seems fantastic. Long-range planning dictates, therefore, that this national defense factor be considered in the selection of new factory sites.

The War Department has neither the authority nor the capacity to remake industrial America. If it had, now of all times would be a poor occasion to attempt any shifting of production facilities from one part of the country to another. What America needs today is maximum production. A wholesale migration of industry would entail loss of time and effort. The policy of the Army is, therefore, to take industry as it stands, chiefly centered outside of the mountains, and to utilize it fully to meet the growing munitions needs.

The primary objective of the Army's armament program is to get the planes, the guns, the tanks, and the other critical munitions as rapidly as possible. Plants already in active operation producing the very things that the armed forces need, can speed up without much difficulty. Such are our shoe, our blanket, and our automobile factories. Those producing collateral items can be converted, but not quite so fast, to munitions manufacture. A plant making locomotives can begin with little delay to produce tanks. The industrial mobilization program aims to distribute the munitions load as equitably as practical over available plants throughout the country that are competent to perform the expected task, with or without some conversion.

New Plants on the Way

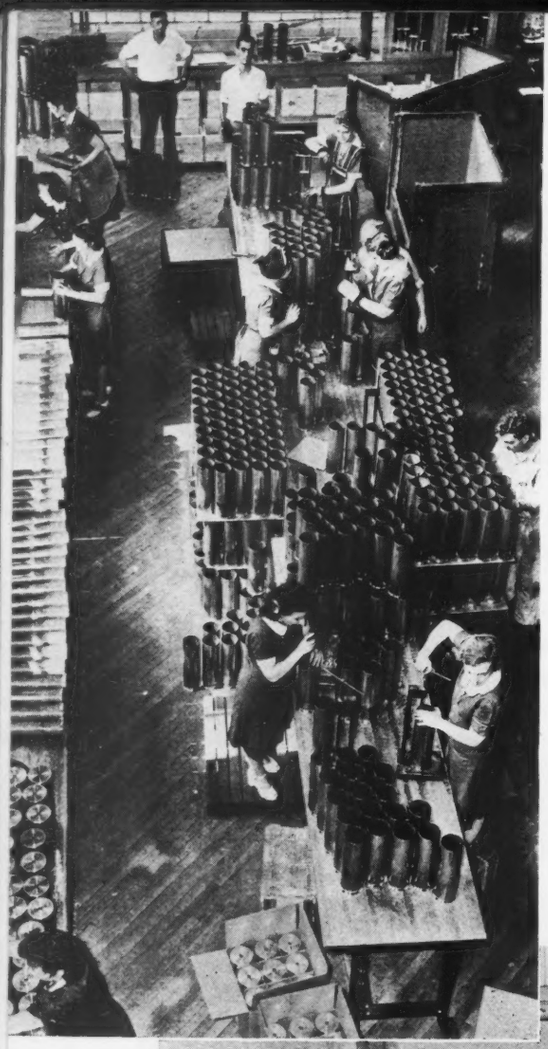
War Department studies have disclosed, however, that, despite America's vaunted prowess in the production field, a serious shortage exists in manufacturing plants adaptable to munitions production in quantity. To meet this shortage, a large program of new plant construction has become necessary, for the production of items for which there is ordinarily no civilian commercial demand. Included are such categories as aircraft, including engines and accessories, machine guns, cannon, explosives, powder, and ammunition.

Wherever possible, industry will be expected to finance the expansion itself. The industrial mobilization program is still predicated on civilian effort. The added demands of the present program, however, are so great that industry could hardly be expected to meet the needs alone. The risk of putting up a plant that might become a white elephant after an armistice is too great.

Will Be Built—and Why

General view of anti-aircraft gun carriage production at York Safe & Lock Company

Vital new war industries, if government financed, will be built largely within the five geographical areas shown above. This map, drawn by FACTORY, illustrates roughly the area "inside the mountains," 220 to 250 miles within our borders. Safety from air attack is the reason. Exceptions will be made in the interest of maximum production. One exception is the proposed Chrysler tank plant near Detroit (1). New powder plants at Charlestown, Ind. (2) and Radford, Va. (3) will be in complete conformity with the rule



There must be some governmental aid; and that need is now recognized.

Wherever a plant is expanded by private industry itself, the War Department, of course, can have little say about the choice of site. Industry, aware of the air threat, might consider the distribution of its production facilities as a matter of caution, but a democratic government could hardly intervene. Where government aids financially, its suggestions might be more cogent. Where it does the building itself, either for use as an arsenal under its own management or for lease to a private organization on a fee basis, the government's voice would naturally predominate.

In selecting locations for the first high-priority plants in its own construction program, the War Department has therefore made the geographical factor of prime importance. It has decided so far as possible to place its plants in the interior of the country. To minimize the hazard of attack from the air, it has ruled out of consideration an area of 220 to 250 miles from the geographical boundaries of the United States. Where the necessities of the situation make it imperative, exceptions will be made to this general policy, but each one will be weighed most carefully.

Five Integrated Areas

This "broad inland area of America" has been tentatively subdivided into five areas—*A*, *B*, *C*, *D* and *E*.

Area A includes northern Indiana, northern Illinois, southern Wisconsin and Minnesota, Iowa, thence westward.

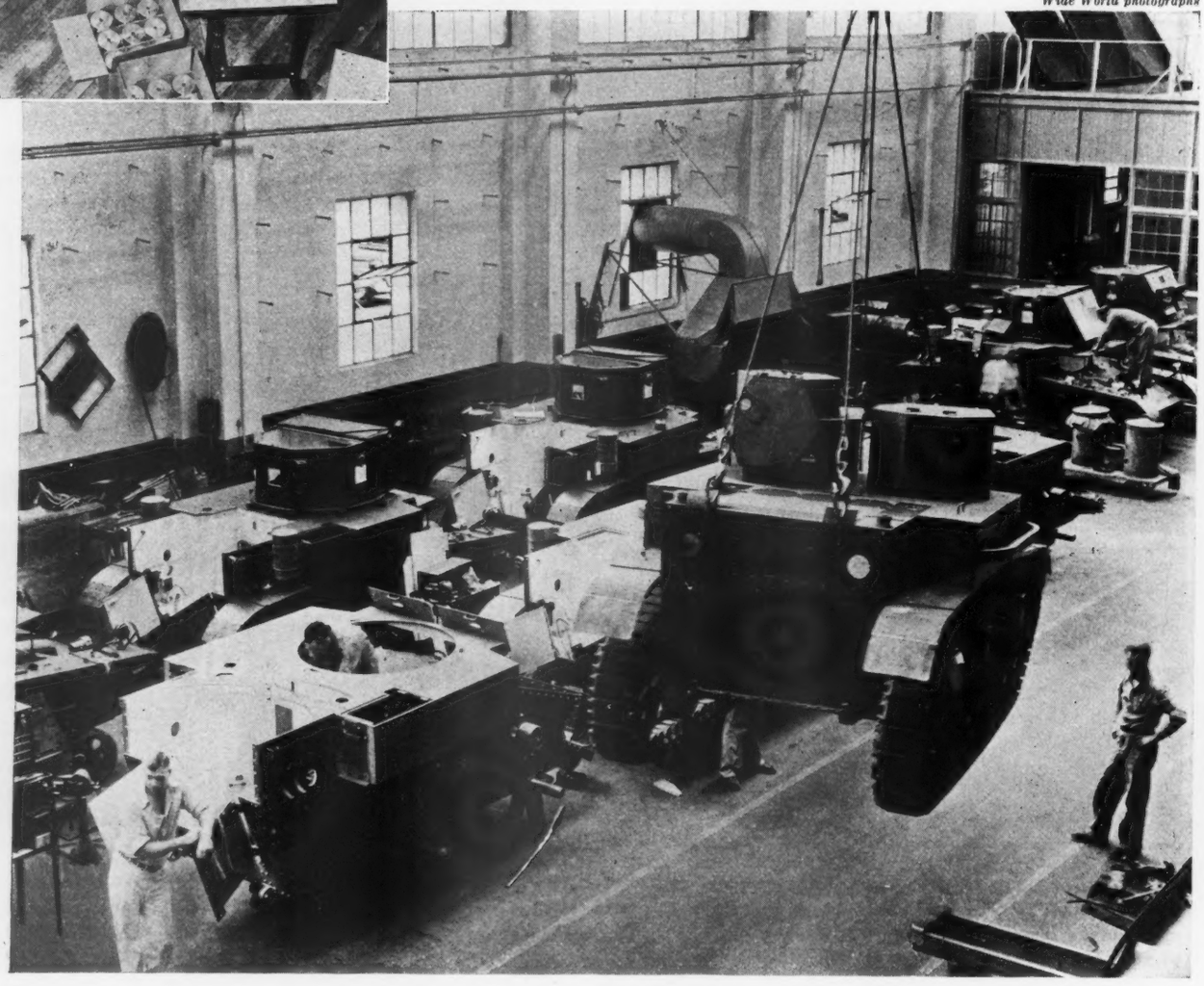
Area B includes Ohio, southwestern Pennsylvania, West Virginia, the western portion of Virginia, and eastern Kentucky.

Area C includes southern Indiana and Illinois, western Kentucky, Missouri, eastern Kansas, and thence westward.

Area D includes western North Caro-

When the defense program hits its stride many plants will make munitions, following production trails blazed by Frankford Arsenal (left) and Rock Island Arsenal (below). New plants will have to be built, some by industry, others—about 60—by government

Wide World photographs



lina, northern Georgia and Alabama, and the eastern part of Tennessee.

Area E includes the western part of Tennessee, northern Mississippi, northern Louisiana and Texas, Oklahoma, and westward.

The areas selected are not watertight. They are merely a guide toward the distribution of munitions plants as equitably and safely as practical. Within each area there will be plants for the production of explosives and powder, ammunition loading and fuse loading plants, plants for the manufacture of machine guns and small arms. Integrated areas such as these will minimize the danger of damage to the whole munitions program if one or two are put out of action.

Having satisfied the geographical considerations, the War Department will then proceed to take into account the economic factors, those that any industrialist would take in selecting a site for his own factory. It will consider the availability of power to meet not only the first but also the expanded needs of these new plants. It will take into account the transportation factor as a means not only of carrying the raw material to the factory, but also of taking it away in its finished form. River, canal and road facilities, as well as those of the plane and the freight car, will be considered.

Plants Must Be Scattered

The availability of skilled labor, housing facilities, proximity to sources of raw material, and other economic factors will play their part. Areas already congested will be avoided. Too many munitions plants too close to one another or to other factories would merely duplicate some of the hazards on the coast. Related manufacturing operations will be grouped into the areas as noted, each reasonably complete within itself. Special demands of individual plants, such as abundant water supply for a powder factory, will be accorded special consideration.

The locations of sites and the terms of contracts already made at the time of this writing are illustrative of the general plan. On July 17, 1940, the War Department and E. I. du Pont de Nemours & Company signed a contract for the construction of a smokeless powder plant near Charlestown, Indiana (about 12 miles from Louisville, Kentucky). The plant will be owned by the federal government. The du Pont Company has been retained to construct and operate it on a fixed fee basis.

Some 4,500 acres of land near Charlestown are being purchased as the site for the plant, which will cost approximately $25,000,000. Construction will require about ten months. The production capacity of the plant will be 200,000 lb. a day.

The construction work will give employment to 5,000 men. The plant, when completed, will require a force of several thousand men.

On Aug. 16, 1940, the War Department announced a similar contract with the Hercules Powder Company for the construction of a smokeless

Government will assume construction costs to get mass production on such complex items as the M3 tank (below) which Chrysler will build. Wherever practical, new plants will be spotted in the inland area, but other factors besides safety may sometimes intervene

U. S. Army Signal Corps photograph

THE AUTHOR

Harris & Ewing

Major Robert Ginsburgh found Army service so interesting, during the World War, that he never returned to civilian life. He might otherwise have been a journalist, a practicing attorney, or a teacher.

A graduate of Harvard University, class of 1917, Major Ginsburgh is a member of Phi Beta Kappa and holds, all told, four college degrees. During the World War, he rose from second lieutenant to captain. Most of his service has been with the artillery and he was for four years a member of the faculty of the Artillery School. In 1933 he returned to Harvard for the study of law and was graduated as marshal of his class in 1936.

In his service as executive assistant, Office of the Assistant Secretary of War, Major Ginsburgh has had close contact with industry and is exceptionally familiar with the problems of industrial mobilization. An alumnus of the University of Missouri School of Journalism and a former staff member of the old New York Morning World, he has written extensively on military and industrial subjects.

powder plant near Radford, Virginia, about 44 miles from Roanoke.

In addition to these two ordnance plants, the War Department on August 15 announced the award of a contract to Chrysler Corporation for the construction and equipment of a military tank plant. The contract includes approximately $20,000,000 for plant and equipment, and $33,500,000 for the production of tanks. It is expected that the plant will be completed for production in about thirteen months.

Chrysler Corporation undertook to procure the site, build and equip the plant, and transfer title to the government, which will reimburse Chrysler Corporation for all costs thereof. The corporation will lease the plant during the period of the contract for $1 a year, operate and maintain it, and build tanks at a fixed price per tank in accordance with Army designs.

The plant will have a floor area of approximately 800,000 square feet and will be located in the Detroit area about 12 miles from the heart of the city on a site approximately 113 acres which is already under option. In the selection of the Detroit area, the availability of the automotive production facilities and the need for speed were treated as a basis for an exception to the general policy. For the initial production desired by the government, it is expected that between 4,000 and 5,000 men will be employed.

In all selections, both as to site and operating agency, the Advisory Commission to the Council of National Defense, and especially William S. Knudsen, in charge of the production division, are playing an important advisory role both to the War Department and to the industry.

In the Chrysler project, Mr. Knudsen requested K. T. Keller, president of the corporation, to make a study of tank production. Mr. Keller and a group of engineering and production executives went immediately to Rock Island Arsenal to inspect the construction of tanks at that place. Some two hundred of the corporation's design, tool, machinery, and production engineers devoted their whole time to figuring on the project in all its details. Their completed estimates were submitted late in July to the Defense Commission, to the Chief of Ordnance, and to the Quartermaster General. Immediately thereafter representatives of the War Department and of Chrysler Corporation began to work out a contract with a view to establishing a basis on which the job could be done in the most expeditious, efficient, and economical way. The above was the result.

These three projects mark but the beginnings. Needs for at least 60 plants for the production of non-commercial items are anticipated. The War Department already has received $44,275,000 in the second supplemental bill, and $200,000,000 in the Second Deficiency 1941 Appropriation bills. The so-called "Four Billion Dollar Army Bill" now before the Congress calls for hundreds of millions more.

The selection of these sites in the interior of the United States may have a far-reaching effect on the whole economy of our nation. National Defense may become the means of distributing more equitably the industrial opportunities of America.

"WHAT INDUSTRY CAN DO FOR AMERICA" IN POSTERS AND SOUND-SLIDE FILM

To facilitate wide dissemination of the story of what industry can do for America, as published in its August issue, FACTORY has arranged for poster and sound-slide film reproduction.

Posters, in color, of the many charts presented, are being produced and sold by Graphic Chart Service, 2-140 General Motors Bldg., Detroit.

The sound-slide film is being prepared and will be distributed by Eugene J. Benge, 20 North Wacker Drive, Chicago.

Monorail Serves Every Press

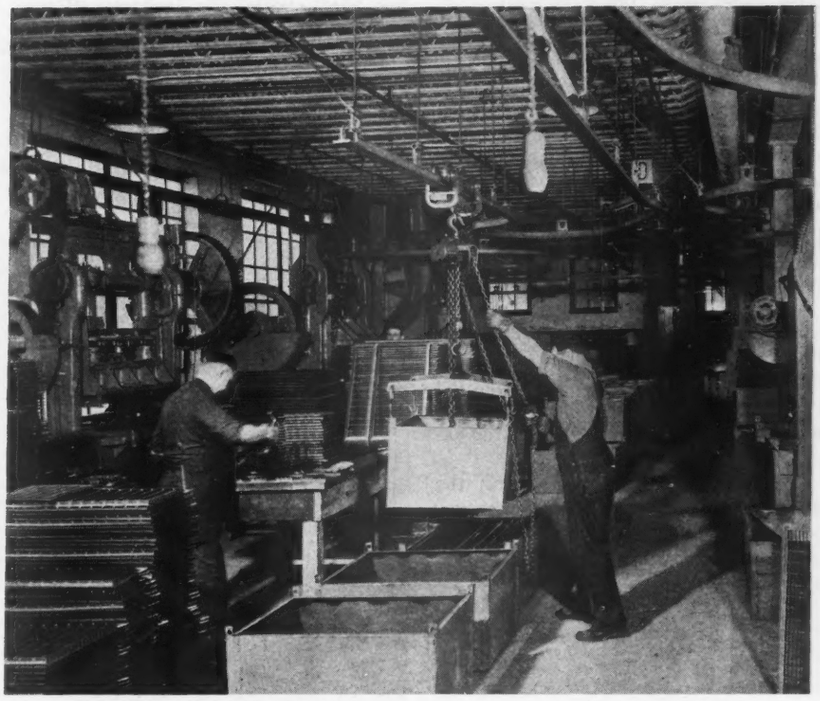
Dies and materials move speedily to and from presses and storage on the overhead rail

AN OVERHEAD TRAMRAIL system connects each press with die storage and the machine shop in the U. S. Register Company plant at Battle Creek, Mich. All but 18 small presses are served in this way. Switches, operated by pull chains, give access to each press so that all presses are interconnected with each other as well as with the storage room and machine shop.

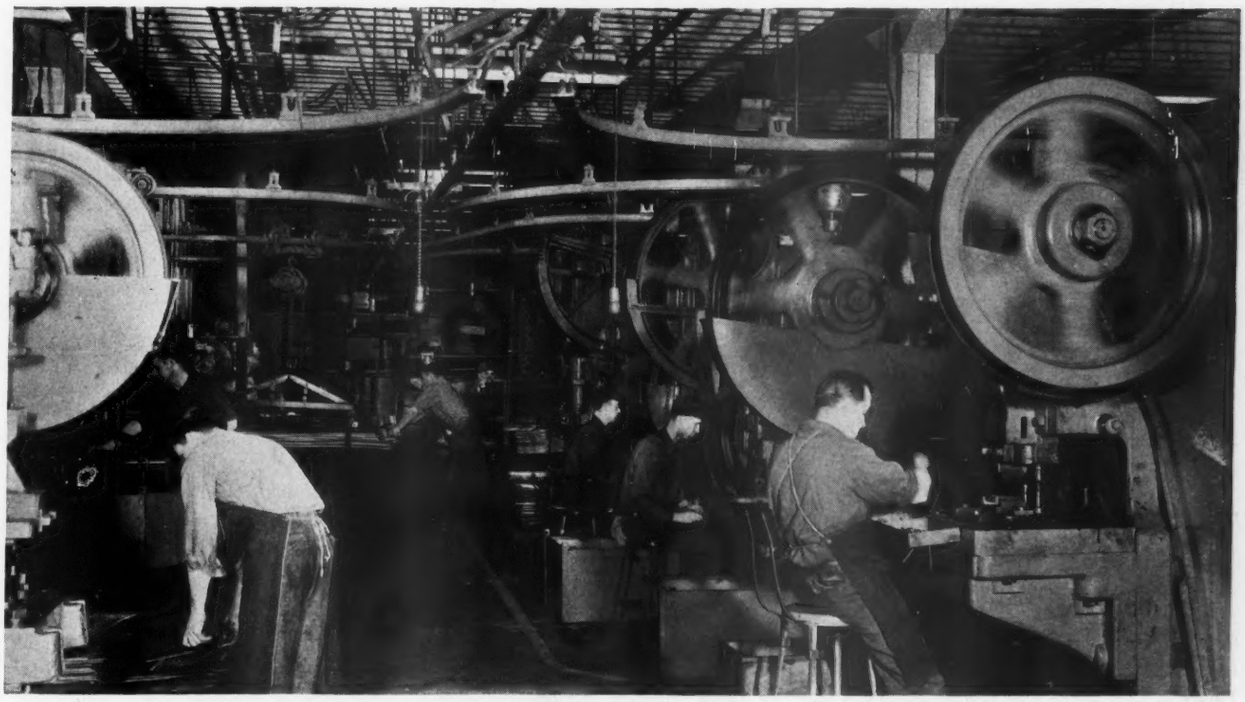
Twelve hand hoists are used in making die changes and in servicing the presses with raw stock, for a branch of the system serves steel storage and the shear department adjacent to it. Dies up to one ton are handled without difficulty and with a three-fourths reduction in time over the three-legged hoist formerly used.

Material boxes of sheet metal are constructed with an eye-hole at each corner. Hand hoists running over the track pick these boxes up by means of the eye-holes and move them from press to press.

In addition to reducing the time for die changes, no accidents in the handling of dies and materials have occurred since this system was installed a little more than two years ago.



Mechanical arms and hands that transport material over the monorail are twelve hand-operated hoists, and materials boxes which have eye-holes at each of their corners



On a special carrier material is brought from shearing to feed the presses. Pull-chain-operated switches lead off to each machine

Can Change Layout in an Hour

Because automobile seat cover styles are as numerous as car models, layout must be that flexible if handling costs are to be kept down and deliveries made on time

H. M. RATLEY

Superintendent of New Development, National Automotive Fibers, Inc., Detroit

AN INCREASING NUMBER of operations required on our line of automobile seat covers and backs forced a change in sewing machine layout. These upholstering units are made for a number of different cars, and in a variety of models for each make of car. The increase in operations came about when we started to make a complete cover, which involved preparation of subassemblies and the joining of these into the completed assembly. Some 110 sewing machine operators are employed in the room in which the change was made.

The old type of layout is illustrated in Figure 1. Sewing machines were lined up on both sides of a conveyor, but there was no sequential relation between machines. The conveyor merely moved the completed pieces to the inspectors at the inspection point.

When all operators are doing the same type of work, and no subassemblies are to be added to the pieces they are working on, this layout is not inconvenient.

New Layout to Speed Flow

But subassemblies came into our picture. To the cloth back for the automobile seat a bottom and top skirt and a right and left side facing had to be added. The layout shown in Figure 1 would have been too costly to operate. Work would not flow through the department fast enough; too much time would be required to shift it from one operator to another; and the cost of moving material around would have made it impossible to meet competition in this highly competitive industry.

These difficulties were met by the adoption of sequential arrangement of these 110 operators into small groups of, usually, six operators to a group. The groups were kept small in order that unbalanced time might be kept at a minimum.

Mr. Ratley served his apprenticeship in tool and die making in Canada, working at the trade for three years before coming to this country. After turns as a bench hand and foreman in a Detroit tool shop, he became successively engineer and plant superintendent in a plant making a pleating machine used by National Automotive Fibers, Inc. In 1929 he came to the latter company to aid in the development of this and other machines used in its processes. His metal-working experience was instrumental in laying out the several plants of this company along mass production lines. Hobbies are fishing, hunting, hockey, and baseball, and, in years gone by, he had quite a reputation in the latter two sports. Rod and gun get workouts at every opportunity

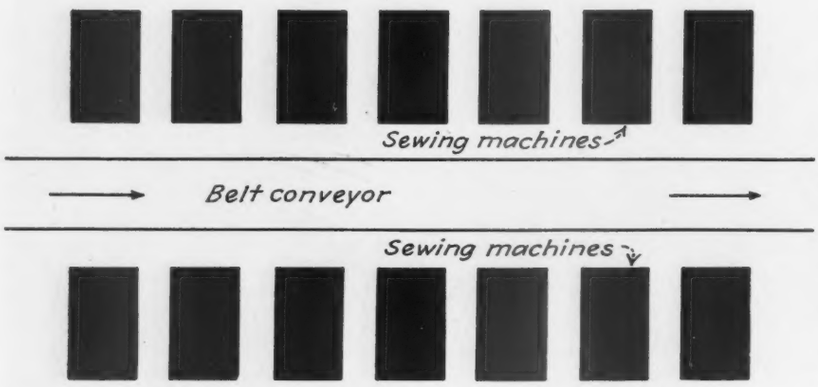


Figure 1. Old layout had sewing machines lined up along conveyor. All operators performed the same operations and placed completed pieces on the conveyor for inspection

The present machine layout is shown by Figure 2. All operations in each group require about the same time. Tables made of five-ply board, and cut to fit the kind of work to be moved from one operator to the next, connect all machines in the group. These sections are hinged, of course, to permit the operator's moving in and out, and are supported by steel table legs.

All sewing machines have individual motor drives, which permits easy re-

arrangement. And this is frequently necessary in view of yearly changes in automobile models. The plywood connections between machines offer no obstacles because they are tailored in our own maintenance shops.

One hour is sufficient to revise completely one of these group layouts. Perhaps it should be explained that the final operator or operators in the group face the 30-in. belt conveyor which moves through the center of this department. The completed work is pushed over onto this conveyor which moves it to the inspection point.

Flexible Power Distribution

The power lead-in from the transformer comes to switch-box panels at one end of the conveyor. Five circuits lead from the panel on each side of the conveyor and are carried the length of the conveyor in pipe conduit with outlet boxes spaced at intervals. A power take-off for each sequential group is plugged into the outlet box at the appropriate position. Because the first-operation machines are placed several feet from the conveyor, some means must be provided for getting power back to these positions. This is done by carrying the power cable, or extension cord, in an overhead pipe supported from the floor. Moving one of these groups then would mean pulling out the plug and shifting the whole set-up to its new location, and plugging in again. Most of the moving, however, can be done by shifting the sewing heads on the machines.

These sequential groups are what may be called final assemblers. The subassemblies for them are prepared by a group of operators at one side of the room. These operators work constantly upon one piece, a top skirt for a back for example. There is no sequential movement of parts between them, hence no grouping. The layout here corresponds to that shown in Figure 1, except that there is no conveyor needed. These operators on subassemblies keep some 20 sequential or group operators busy on final assembly.

Stock girls move the subassemblies to the proper group operators. Subassembly operators work, or are scheduled, about four hours ahead of the needs of the group operators. The parts are stacked by the stock girls in a metal tray above each group sewing machine within the normal vertical grasp area of the operator.

The first operator in the group receives backs from the cutting room. She takes her subassembly from the tray and sews it to the back. She then pushes this ahead, over the plywood table, to the next operator who adds her subassembly. In the same way the back is passed down until it is pushed over onto the conveyor by the last operator. The conveyor takes it to the inspection point.

This form of layout permits a rapid and easy flow of work in the department. Less confusion, less materials handling, and less work in process is involved. A revision in layout can be made quickly. An increase in the schedule requirements of our customers is handled by duplicating the sequential groups; in fact, such groups are already set up, awaiting only an increase in schedule.

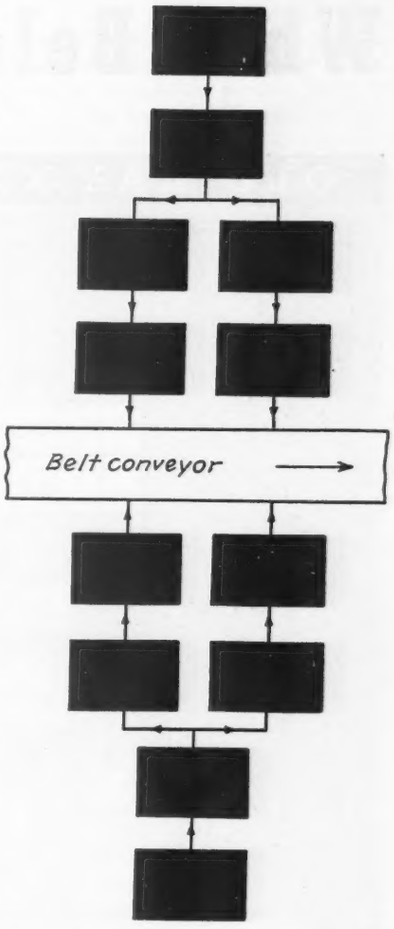


Figure 2. In new layout operators and machines are arranged in groups of six for final assembly. Pieces pass from one operator to next, moving toward the conveyor. Last operator places them on conveyor which takes them to inspection

Rearrangement of this six-operator battery of final assemblers in one hour's time is made possible through use of individual machine drives, flexible power hook-up, and plywood tables—quickly made in the plant maintenance shop—along which work is passed

What Belongs in the Methods

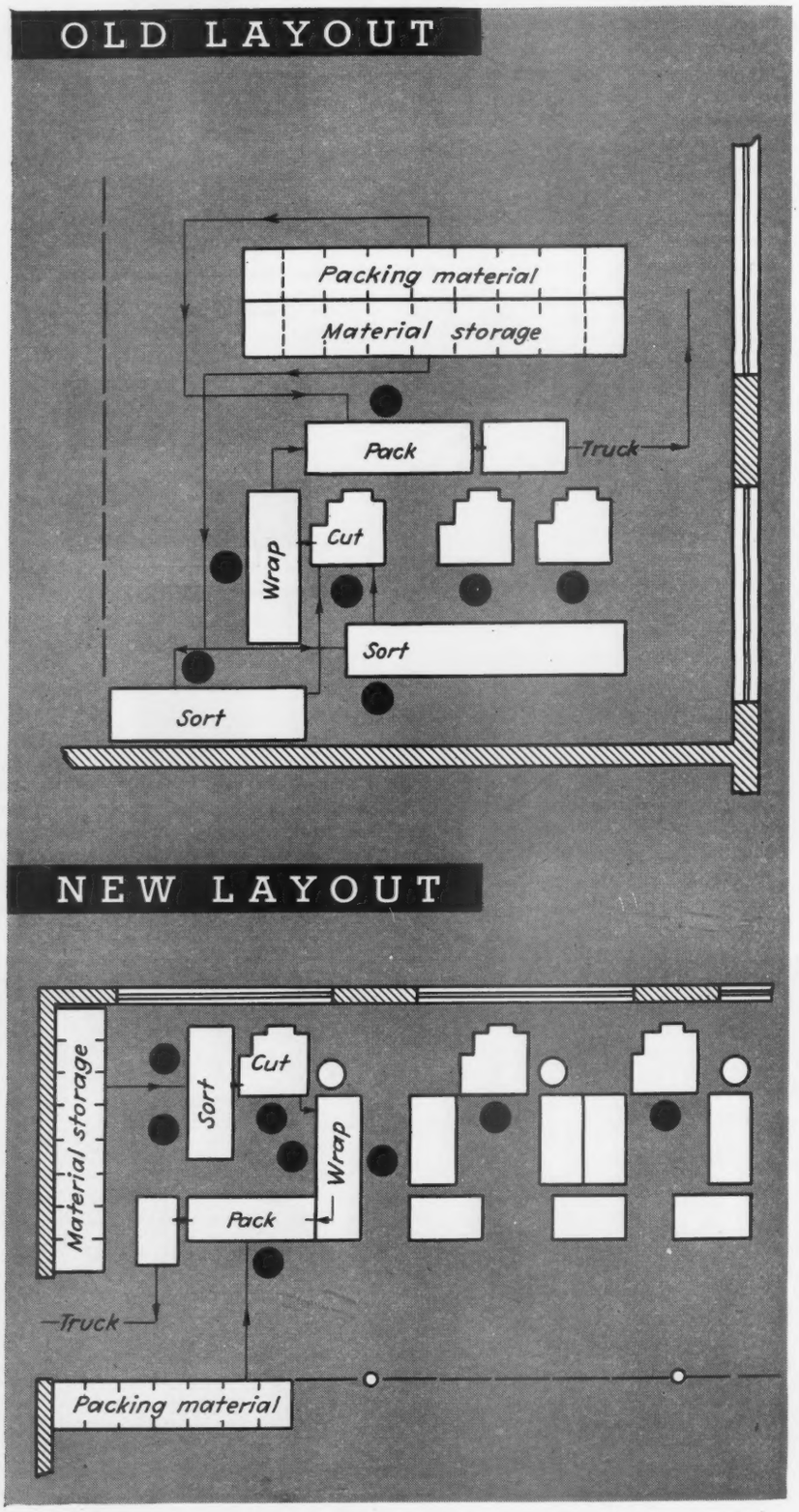


Figure 1. Old and new layouts for a series of operations. New arrangement affords shorter, more direct handling of materials; guillotine and tables are more accessible

In July the author described preparatory groundwork for the work simplification program. In this article he outlines the program and tells how it should be conducted

LEE S. WHITSON
Consulting Industrial Engineer
Minnesota Mining and Manufacturing Co.
St. Paul

FIRST MEETING of the motion economy program should start on a note of enthusiasm, for this will affect the tone of the whole project. The plant superintendent should introduce the program and explain briefly its objectives. The economic necessity for cost reduction to meet competition and to permit higher wages and bonus earnings should be emphasized. The foreman's position as a representative of the management and his responsibility for economical production should be brought out.

Then the meeting should be turned over to the man in charge of the course for further explanation of what motion study is and how its gets results. It should be brought out that motion study is fundamentally the application of common sense in working out the best and easiest methods for doing work, and that it gets results through better methods rather than by speeding up the operator. A brief history of how motion study was conceived and developed should be included.

Use Motion Pictures

Next comes a discussion of some of the general means of improvement—systematizing the work, eliminating unnecessary operations, and developing better methods and work station layouts. These should be illustrated with motion pictures and demonstrations.

The need for an open-minded questioning attitude in methods work should be brought out, possibly with a few humorous anecdotes for illustration. It should be explained that the class discussions of plant operations are in no way intended as criticism, but that the entire group is working together toward one common objective—better methods.

Study Program

In practically any type of plant it is desirable for foremen and supervisors to be able to follow through a process and recognize poor flow of materials, poor handling methods, or a questionable organization of the work. Thus, the central theme for one meeting might well be "How to study and improve the process as a whole." Since the need for such studies is not always recognized, it is well to start the meeting with a demontration of the cost of handling and moving materials. A case history from some other plant or department can be used. This might be presented by motion pictures or by means of a flow diagram drawn on a floor plan to show the travel of materials.

One such flow diagram we used showed a series of operations in preparation of outsoles in a Minneapolis shoe factory. After the soles were cut and flexed, they were trucked a distance of 175 feet to a wire-brush machine which roughened the edges of the soles prior to application of cement. After the edge roughening, the soles were hauled back over the same 175 feet to the cement applicator which was located right next to the flexer.

Saved 350 Feet of Travel

No one had given thought to this excessive travel until the department supervisor made a chart of the process. The reason for the long haul was that the wire brush supposedly had to be located near a window so that leather dust could be exhausted outside. The supervisor, exercising his ingenuity, attached a filter bag to the exhaust of the machine to catch the dust, and the machine was then moved to a location adjacent to both the flexer and the cement applicator. Bringing the three successive machines together saved 350 feet of travel and eliminated the work of loading and unloading the truck at each end of the trip.

After the group has seen such an example of poor layout, they should be asked for suggestions for simplifying the flow of work, and possibly a rough form of improved layout can be developed. This discussion should be followed by showing a flow chart or motion picture of actual improvements made in the process being considered. If the improved arrangement includes some of the suggestions advanced by the group, it will help develop a confidence in their own ideas, since their thoughts will be seen to agree with those of the person who actually developed the new layout which they are considering.

Having demonstrated the possibility for improvement, we might well end the meeting with the question: "Which of our own processes can be improved by a similar type of study?" This question should be made a definite assignment, and each member of the class should be expected at the following meeting to suggest some process for study by the group. This will force each person to do some very definite thinking about the subject and to question his own processes for possible improvement. Before the following meeting, the person conducting the class should visit each member to assist him if necessary in selecting a process for study. We have found that such contacts with the men in their own departments are valuable in building up personal interest in the program.

The following meeting might be opened by a very brief review of the process improvement presented at the previous meeting. The group should be asked for suggestions as to how such a study might be made, and then the process chart should be introduced as a tool to be used in working out problems of this kind. Another example of improvement through use of the process chart should be presented—preferably a simple improvement, and one developed by either a foreman or supervisor.

The flow charts in Figure 1 show such an improvement worked out by a department head after he had made a chart of the process. This problem concerned the arrangement of tables and equipment to simplify the handling of material at a particular production center. The process is that of sorting, cutting, wrapping, and packing small sheets of material. In the old layout the first operation was practically inaccessible from the aisle and was far from the material storage space. Handling of material from one operation to the next was awkward and necessitated the guillotine operator's turning completely around to get his material.

The lower diagram shows the improved layout. The first operation is adjacent to the material storage, and the work flows smoothly through the process. The guillotine operator gets his material from beside him rather than from behind him. The two guillotines at the right, used for special jobs, were also made more accessible to the aisle.

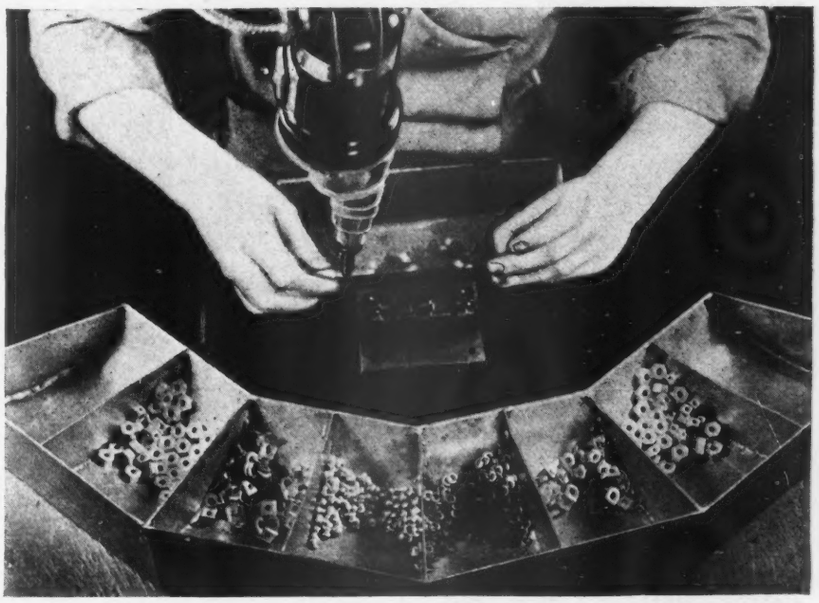


Figure 2. Improved work station for small assembly features semi-circular arrangement, power screwdriver suspended over workplace, holding jigs for two-hand operation

At this point the processes suggested by the group should be reviewed and one of them selected as a class project. Then the class should adjourn to the plant to follow through the process and make a chart of it. This meeting might well end on the question of possible improvements in the process studied. With forethought, the leader of the class will see that the process selected for the group problem has plenty of possibilities for improvement. At the fol-

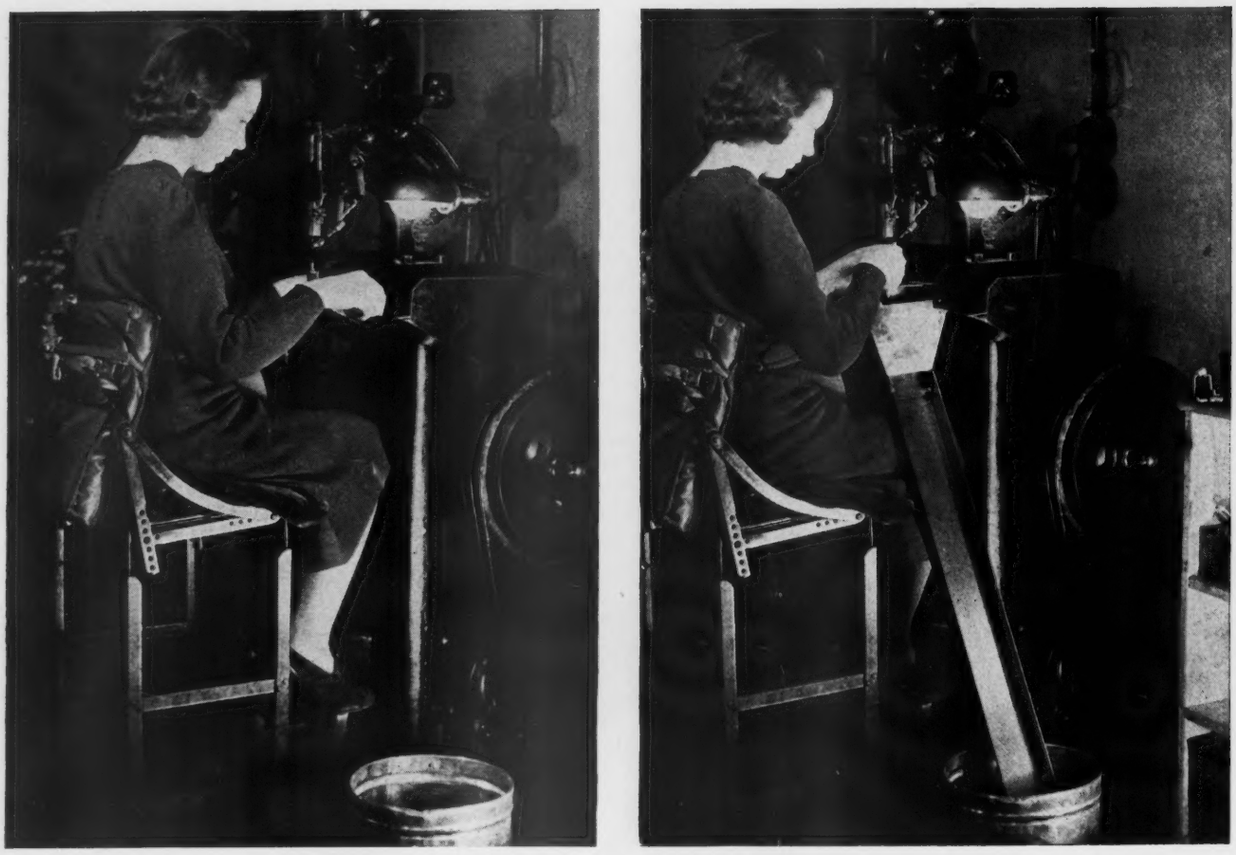


Figure 3. Use of chute for disposal of small parts eliminates two-foot reach formerly necessary in hand disposal technique (left)

lowing meeting, suggested improvements should be discussed and listed on the blackboard. These suggestions should be definitely followed up, both for their own value and to encourage further thinking by the group.

Since it will be impossible to follow through more than one of the processes suggested for study, the class members should be encouraged to follow through and chart their own processes outside of class. This will be particularly valuable since it will relate the class work more definitely to the supervisor's regular work. The class leader should assist in the study of these processes and help the men work up suggestions for improvements.

Another meeting might profitably be devoted to the arrangement of the work station and the placement of tools and materials. This subject might be introduced by a demonstration or motion picture of an operation that was improved by changing the work station layout.

Figure 4. Production was increased 67 percent on spice box dredge assembly by having punch press operator make pre-assembly which two other girls had formerly done for her. The two hoppers and change in method eliminated wasteful, time-consuming handling

Each Hand Makes Assembly

Figure 2 shows the improved set-up for a simple operation—that of assembling a brass clip on a small bushing with a screw and lock washer. This assembly is used in a heat regulator mechanism. Duplicate holding jigs are provided, and two assemblies are made simultaneously with the two hands. The parts are arranged around the work place, and duplicate parts are located symmetrically on either side. A power screwdriver is suspended over the holding jigs on a counterweighted cord.

In the old set-up, the parts were arranged in a hit-or-miss fashion on the table, and the operator held the assembly in one hand while she worked on it

(Continued on page 148)

Training People for Factory Work

J. W. VANDEN BOSCH
Secretary, Cleveland Personnel Association
and
Manager of Information and Statistics
Cleveland Chamber of Commerce

Case history of a community effort to prevent the national defense program from bogging down for lack of skilled factory workers. How Cleveland, with the full cooperation of industry, school authorities, and government agencies, is training "learners" for jobs that are open or will be open

Forty-second in the Series of FACTORY MANAGEMENT and MAINTENANCE Plant Operation Library

Training People for Factory Work

SHORTAGE OF SKILLED WORKERS will not bog down our national defense program if results already achieved in Cleveland along training lines are indicative of what every industrial community can do to swell the ranks of skilled men—and women, too, if necessary—so sorely needed in our accelerating preparedness drive. Here is a fair example of the rapid progress possible when *all* agencies that can contribute to such a program in a community are determined that the common welfare shall be served, and cooperate to achieve tangible results.

United in this effort are the Cleveland Personnel Association, Cleveland Chamber of Commerce, Cleveland Board of Education, and the federal agencies of WPA and NYA. The results of this cooperation have been tangible and practical. Men are being trained for jobs that are open or will be open; there are close, friendly, and constant contacts among all the agencies; there will be no over-emphasis on training one type of worker to the neglect of another type; the industries will not be handicapped by shortages of men; and the men themselves will be benefited by the learning of new skills and the relearning of old ones.

Facing Labor Shortages

All this has been done in the face of a real problem. Preliminary surveys had shown that most plants were not working at capacity and would face a shortage of skilled labor when the momentum of the defense program pushed their production to the ceiling. Besides, skilled labor had been leaving the city to take jobs elsewhere, some in government arsenals. In order to clarify the situation the Personnel Association carried on a still more exhaustive investigation to ascertain the facts, and now serves as a clearing house of information, a coordinator of effort, and a prognosticator of future manpower needs for industry.

Rapid progress has been registered in the several training centers, under regularly constituted authority, and the response of the young men who were eligible for training was unmistakably favorable, for the classes are crowded, interest is intense, and arrangements have been made to handle about 2,000 trainees during the fall period.

The opening gun in the program was set off in May when Frederick C. Crawford, president of the Chamber of Commerce and of Thompson Products, Inc., emphasized the need for "a central body which could speak with authority on the subject of manpower needs in essential defense industries." He pointed to the Personnel Association, a closely knit organization representing 28 major industries in the area, all of which are members of the Chamber of Commerce, as uniquely constituted for this purpose. All its members were on the firing line, he pointed out, with complete knowledge of the employment situation and in a strategic position to furnish that information promptly to training agencies.

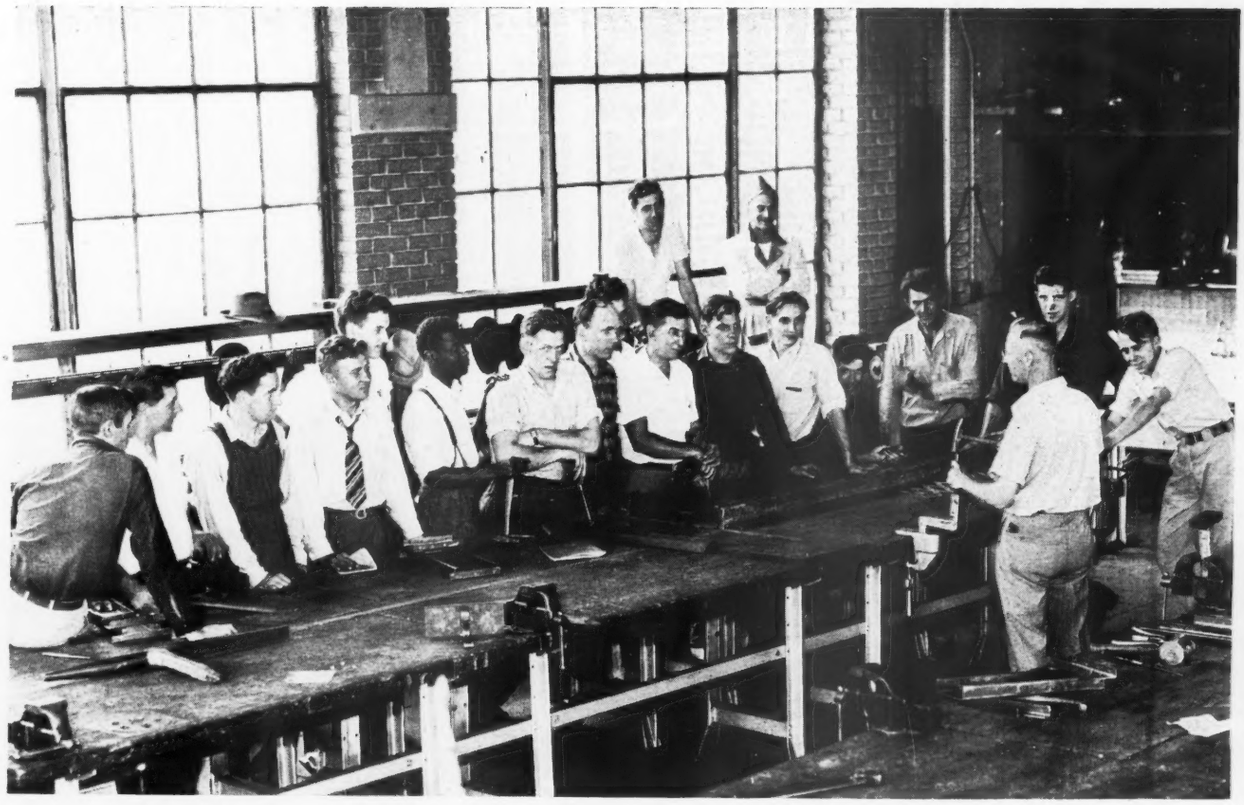
In the meantime, and before the federal government had announced its plans for a vocational training program, the Cleveland Board of Education had already visualized the coming needs and started classes in machine shop practice outside the regular curriculum. Unemployed young men were registered as trainees.

The Personnel Association first surveyed the field and then began a series of important conferences with the authorities in the WPA, NYA and the school board, in an effort to synchronize all training efforts to a common goal, geared to the immediate and logically expected needs of industry.

The result was that Cleveland quickly established a well-organized and going program, cooperating with the Department of Education in Washington and with all the established agencies dealing with men and jobs in Cleve-

ABOUT THE AUTHOR

J. W. Vanden Bosch has been "loaned" by the Cleveland Chamber of Commerce to the Cleveland Personnel Association during the defense emergency to act as secretary and to set up a clearing house of up-to-date information regarding the immediate and contingent needs of essential war industries for trained manpower. Mr. Vanden Bosch has been instrumental in securing the energetic cooperation of all the important training agencies in driving ahead on a practical and resultful program. His work with the Chamber of Commerce during the past sixteen years as manager of information and statistics has brought him into close contact with the major industries of the city, and has enabled him to call upon a wide acquaintance and a large group of friends in carrying out his important task in Cleveland's community training effort



More than 600 young men have been in training since midsummer in two Cleveland technical high schools, one regular high school with machine shop facilities, and one trade school. Ages vary from 18 to 35. Here Willett M. Riley, supervisor of metal-working trades at the Cleveland Trade School, shows a group of learners "how." Instruction in the metal trades shop includes riveting, soldering, seam work, acetylene and electric arc welding, angle iron and band iron work, and structural shape work

land.. Good leadership, prompt action based on well-authenticated information, and consistent plugging are solving a difficult problem at a time when delays and errors might be fatal.

Once the question "What part shall the Personnel Association play in this situation?" had been decided, the association started to work. Careful research was instituted with respect to the question of labor shortages—where they were; in what industries; what companies in those fields; the extent of the shortages, both current and anticipated; and what training would suffice to prepare men to step in to fill the jobs. Also, where human material could be found, in what numbers, how men should be selected, and how the training should be conducted—where, with what equipment, and in what course.

The Association presented facts as it found them. The press shops were found to have no particular "headache." The bolt and nut industry presented no difficult problem, although it might be swamped if work began to come in too fast. The steel industry, with its constant fluctuations in production, usually has a reservoir of trained help to call upon for a higher rate in operations. Since about 70 percent of the bolt and nut industry was represented on the committees and the steel concerns had 100 percent representation, the analysis was believed authentic.

The jobs listed as open by 31 major industries involved 26 specific types of work, practically all of which were connected with metal working machines. The greatest demands were for hand screw operators, assemblers for machines requiring fitting, grinders, toolmakers, skilled operators of precision machine tools, and automatic screw machine operators. The last-named category appeared to be distinctly undermanned, even under normal operating conditions.

Some of the significant facts that were turned up by the initial survey indicated that:

1. Twenty-three foundries, currently employing 5,000 men, will need 700 core makers, molders, and pattern makers under full operation.

2. Higher production rates in the same plants will require an additional 300 to 500 workers.

3. Forty-five of 73 plants will need 122 general draftsmen when operating at 50 percent above normal.

4. Fourteen concerns need 42 general draftsmen at once.

5. Firms represented by the members of the Association stand in need of numerous layout men, time-study men, tool and die designers, detailers, and production and planning men.

Contributing to the shortage in skilled men, more than 500 mechanics had left Cleveland industry during the previous three-month period to take positions in arsenals, navy yards, and torpedo stations, according to the Secretary of the Cleveland Division of the U. S. Civil Service Commission, and this drift was still apparent. They were attracted to government service by appeals of security and special privileges attached to federal employment.

At the time the results obtained from the initial survey were announced, public statements were heard to the effect that there was no labor shortage. There were 1,000 skilled men in Cleveland looking for jobs, it was asserted. Doubt was cast upon the industrial training program. In some quarters the program was alluded to as "a scheme to lower the standards of labor". There was a wide disagreement between industrial employment officers

who were endeavoring to fill departmental requisitions and the keepers of unemployment registration files.

To clarify the situation in the minds of the public, the Association immediately carried out a still more exhaustive investigation to ascertain the facts. Its chairman, Ray Livingstone, Director of Personnel for Thompson Products, Inc., made public a summary and report in which he replied to the assertion that there was no shortage of skilled labor, that the plan under way was impractical, and that there were hundreds of men in Cleveland to fill these imaginary places. (One personnel director asked "Where in the hell are they?")

Here are some of the highlights of his report:

1. There has been for many years an almost complete cessation of training plans in industry. Young people have been attracted to "white collar" jobs. While a vast majority of the workers in Cleveland are in factories, our educational system trained only a few for shop work.

2. Certain industries were experiencing difficulty in finding trained men. Definite shortages are known to exist in several classifications: skilled mechanics, for example, several classes of foundry workers, draftsmen, and other technicians.

3. The strongest demand for skilled workers will come from those fields in which heretofore two to four years of learning had been considered the minimum requirement, and now time will not permit such long courses. Industry can use men who know how to operate one machine, or two machines, yet who are not all-round machinists. Training programs of shorter periods have produced men who have become quite useful in plants where machine operation is the major occupation.

Top, James Flowers faces a vise base in a four-jaw chuck. James is 19, a high school graduate with no shop training and no industrial experience

Center, Shelby Coffman, also 19, is cutting a gear on a milling machine. Shelby took an arts course in high school, has never worked at machine trades

Below, W. W. Roseberry faces a casting in a four-jaw chuck on a lathe. He's 42, had a year in college, no shop experience. At the end of seven weeks of training he was given a job in Warner & Swasey's machine shop. His working hours will permit him to complete his 200 hours of training. All three photographs were taken at the East Technical High School

4. Many of the men who are said to be available have had experience on an assembly line where the operation was entirely repetitive, whereas the need is for men who can work from a blueprint. make a complete set-up and run a job with a minimum of supervision.

5. It must be considered also that industry has standards for employees which are in addition to mechanical skill alone—good character and habits, good health, and a satisfactory record of previous employment. Unfortunately, many of the men on the rolls of employment agencies have been previously employed and their records are unsatisfactory. The companies must safeguard the welfare of their employees, and protect their property from anyone who is unreliable or unfitted for important mechanical work. It is not surprising that not all the unemployed men who are experienced in shop work will fit into this program.

Meanwhile, the training was getting under way. Under the leadership of Charles H. Lake, Superintendent of Cleveland schools, and with the personal direction of Frank C. Moore, Directing Supervisor of Industrial Arts, more than 600 young men have been in training since midsummer in two technical high schools, one regular high school with machine shop facilities, and one trade school.

From Ranks of Unemployed

In the trade school, subjects taught are auto mechanics, foundry practice, welding, sheet metal work, and pattern making. In the high schools the trainees are being drilled in the operation of lathes, milling machines, grinders, and drill presses. The ages of the learners vary from 18 to 35, with a preponderance in the 18–27 age group.

All the workers are from the ranks of the unemployed. In order to secure a place in the classes, an applicant must be recommended by the Ohio Employment Service, the placement arm of the Unemployment Insurance Commission of the state. Then he is interviewed by two expert machinists, by the principal of the high school or trade school, and by the teacher in the section in which the applicant desires to train. Then he takes a spatial relations and a mechanical aptitude test before being actually admitted.

Men who are on the WPA rolls must be recommended by the supervisor in charge, and the employment office is notified as each man is sent to the high schools. The result of the interview is entered on his record.

Beginners and advanced students are accepted without discrimination. Due to a federal regulation, not less than 50 percent of the enrollees must come from WPA rolls, and some $9,000,000 was appropriated by the Washington office for the purpose of paying the allowance of WPA men who take this course in different parts of the country. The federal Department of Education has also allotted $7,000,000 to assist in training work throughout the nation.

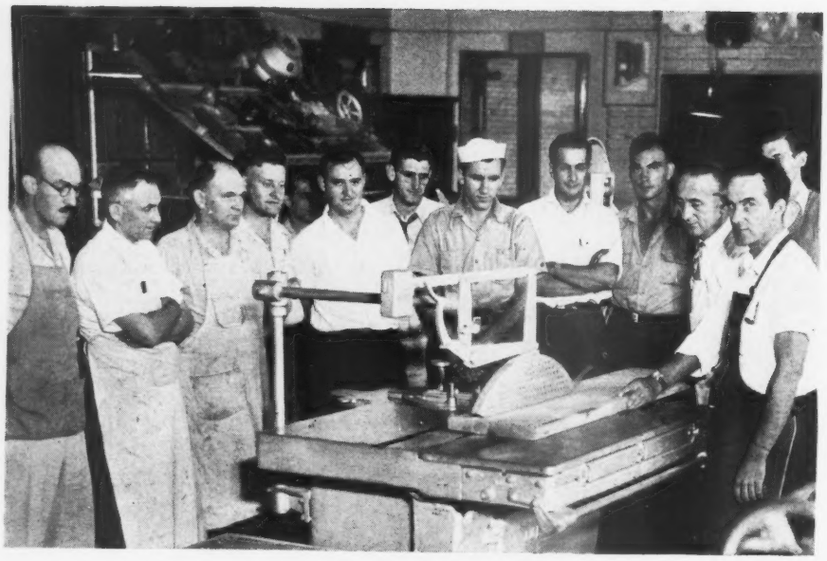
The work schedule calls for eight weeks of attendance, five days per week, four and one-half hours per day.

The instructors are regular teachers, under contract to the school board, who have had three or more years of prac-

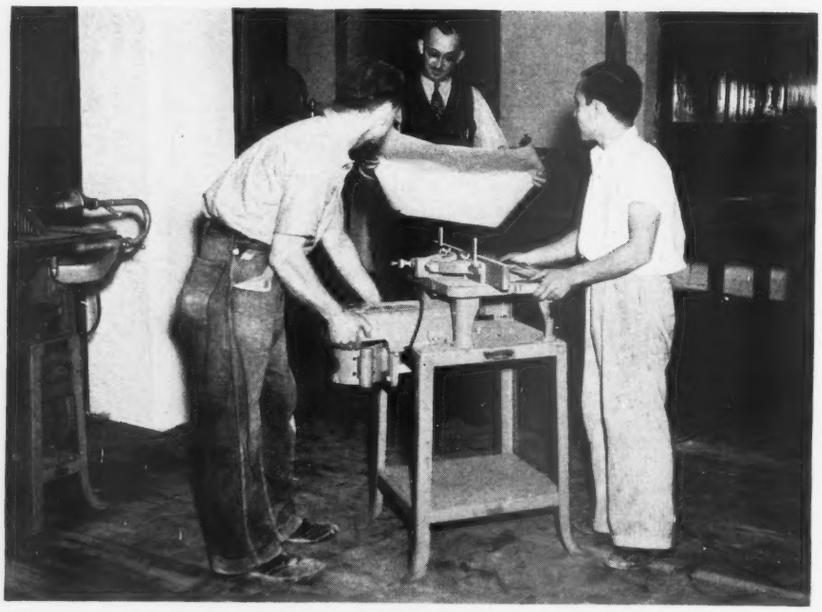
THE MEN BEHIND THE TRAINING

Cleveland Personnel Association
Executive Committee and Sub-Committees

EXECUTIVE		
Ray S. Livingstone (Chairman)	Personnel Manager	Thompson Products, Inc.
H. O. Anderson	Personnel Director	National Acme Company
R. J. Blyth	Employment Manager	Warner & Swasey Company
E. W. Kempton	Dir. of Industrial Relations	American Steel & Wire Co.
Dr. H. W. Lawrence	Personnel Director	The Fisher Body Company
George J. Leroux	Works Manager	Nat'l Mall. & Steel Castings Co.
A. J. Reitz	Employment Manager	White Motor Company
R. S. Sadler	Personnel Manager	Cleveland Graphite Bronze Co.
Col. L. P. Wolfford	Manager, Personnel and Welfare Department	Addressograph-Multigraph Corporation
BOLT AND NUT		
F. W. Oldham (Chairman)	Personnel Manager	National Screw & Mfg. Co.
Harold L. Judd	Personnel Director	The Lamson & Sessions Co.
Frank G. Kaufman		Cleveland Cap Screw Company
Edward Mandray	Supervisor of Ind. Rel. Bolt & Nut Division	Republic Steel Corporation
H. A. Sammons	Paymaster	Ferry Cap & Set Screw Co.
FOUNDRY		
George J. Leroux (Chairman)	Works Manager	Nat'l Mall. & Steel Castings Co.
B. H. Aiken	Superintendent	Crucible Steel Castings Co.
R. C. Hamburg	Superintendent	Eberhard Manufacturing Co.
Malcolm Love	Employment Manager	Ferro Mach. & Foundry Co.
F. W. Pascoe	Foundry Superintendent	Westinghouse Elec. & Mfg. Co.
H. G. Wellman	Secretary & Treasurer	Wellman Bronze & Aluminum Company
MACHINE TRADES		
H. O. Anderson (Chairman)	Personnel Director	The National Acme Co.
R. J. Blyth	Employment Manager	Warner & Swasey Company
A. J. Reitz	Employment Manager	White Motor Company
PRESS SHOP		
J. D. Lyle (Chairman)	Asst. Personnel Manager	The Fisher Body Company
T. E. Ames	Employment Manager	The Murray Ohio Mfg. Co.
Wm. C. Lehman	Personnel Manager	American Stove Company
A. J. Livingston	Employment Manager	Midland Steel Products Co.
J. M. Rowan	Personnel Manager	Perfection Stove Co.
R. S. Sadler	Personnel Manager	Cleveland Graphite Bronze Co.
F. M. Small	Personnel Manager	Truscon Steel Company
STEEL		
E. W. Kempton (Chairman)	Dir. of Ind'l Relations	American Steel & Wire Co.
G. S. Ashmun	Asst. to Vice President	The Otis Steel Company
R. S. Easterday	Secretary	The W. H. Davey Steel Co.
Ray S. Livingstone	Personnel Manager	Thompson Products, Inc.
J. A. Voss	Dir. of Ind'l Relations	Republic Steel Corporation



Some of the boys couldn't resist the desire to peek when FACTORY'S photographer snapped this group of learners in the pattern making department at the Cleveland Trade School. Frank C. Cech, instructor, demonstrates the use of a power rip saw



Trainees at the Cleveland branch of the National Youth Administration learn to "line up" a machine from a floor plan, under the guidance of Spencer D. Ogborn, consulting technician. The NYA boys set up more than a hundred modern machines (bought with Federal funds) in the new seven-story building recently taken over by the organization, without any outside help. Classes totaling 350 men were started August 15

tical experience in the work they are teaching, in addition to the other requirements for all high school teachers in Cleveland.

For the new group that started August 1 at the regular high school, where new quarters were opened because of the increased demand for this training, the schedule calls for five weeks' training, six hours per day, five days each week. Evening classes will be inaugurated during the fall months in all training centers.

The federal government has appropriated $15,000,000 for the purpose of purchasing equipment for this program, also paying for power maintenance, supplies, and instruction. Cleveland's share of this money will probably run about $50,000. The Board of Education supplies the building space and supervision without cost to the government or to the learners. The board has notified the officials of industrial concerns that wherever a group of not less than 20 men desire instruction in machine operation, either beginners or experienced men who wish to improve their skills, the board will furnish instructors.

The five basic arts of metal working are taught in the classes—milling, planing, turning, boring, and grinding.

There are three classifications with respect to the personnel:

1. Young men over 18 who wish to learn a trade in machine shop work.

2. Unemployed older men who show an aptitude for mechanical work.

3. Unemployed men who have had previous shop experience and who wish to take a "refresher" course or to learn a new trade.

Instructors in the machine shop classes state that they have never witnessed such an intense and universal interest as these learners are displaying. Many are heads of families. They have a firm purpose which is reflected in the seriousness with which they go about their tasks.

All classes are carried on under the joint direction of the U. S. Department of Education and the Cleveland Board of Education.

In a newly leased seven-story building on East 57th Street, the Cleveland Division of the National Youth Administration has set up more than 100 modern machines for the training of men in the age group 18–25. Students are selected from the rolls of the organization by a staff headed by Spencer D. Ogborn, formerly consulting engineer for many metal-working establishments. He has been appointed consulting technician and director of training. Classes totaling 350 men were started on August 15.

For instructors Mr. Ogborn has chosen men who have had industrial experience within the past six months. He does not discriminate in the matter of conventional education, but he insists upon good English, clean and neat appearance, a good voice, knowledge of the work and the power to convey that knowledge to others. He wants patient, sympathetic teachers who will "put the ideas across," whether it requires one telling or a dozen. He says he wants to know whether the applicant for an instructor's position "has children of his own, and whether he likes dogs." Only such men, he believes, have the necessary good nature, patience, and understanding to deal with youth. The instructor must be physically strong, "with two good hands and two good feet"—not a weakling—and capable of handling heavy tools without straining his back.

Standardized instructions have been

set up for the operation of each machine, and a ratio of performance has been established, based upon reasonable expectancy. "We want men who will not spend all afternoon drilling a hole," declares Mr. Ogborn, "and we expect to give these boys real shop lingo and atmosphere; yes, and real shop tempo! We are not going to be ashamed of these fellows when they go to work in a plant."

NYA enrollees receive an average of $24.50 for a month of 70 hours. The pay rate starts at 33 1/3 cents per hour, and advances to 38 cents. In addition to training for practical production work, each student must spend 44 hours in classes each month on his own time, studying blueprint reading, micrometer and vernier caliper readings, shop mathematics, use of precision instruments, and the use of internal and external gages.

Plans to Train Women

The two lower floors have been set aside for the metal-working trade groups, with a variety of work on the other floors, including woodworking, mimeographing, domestic science, hospital and laundry work, and a radio division. So far young women have not been selected for metal work, but Mr. Ogborn says he will not be caught napping, and if young men are called for military service he will begin training young women for machine shop trades. The machine work includes turning, milling, drilling, sheet metal work, punch pressing, and toolmaking.

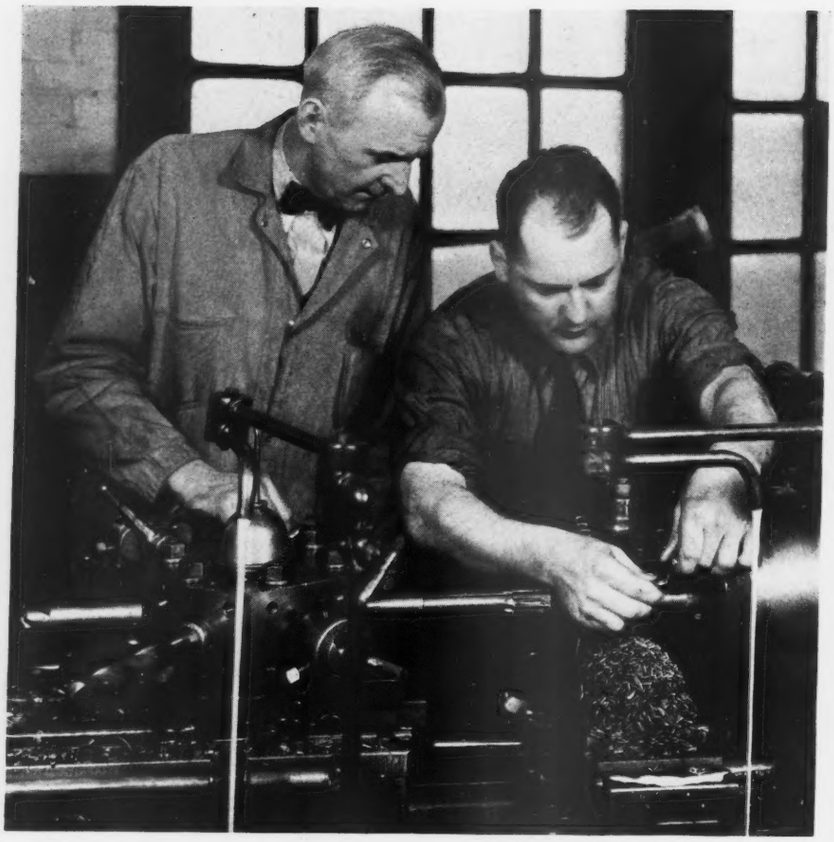
There is no rigid schedule at the NYA so far as the completion of a course of training is concerned, but a minimum of 80 hours is required. Mr. Ogborn hopes to have young men ready for calls from industries as the calls come in, and if no opening occurs when a student has mastered one type of machine, he will go on to the next one. The longer he is in the shop the more skilled and ready he will be. But, as one man is called out into private employment, another will be selected to take his place; thus the work will be continuous and flexible.

The entire establishment is conducted much like a large manufacturing plant, with a receiving department, shipping room, raw material and finished stock rooms under perpetual inventory, with requisitions necessary to draw materials; frequent inspections (young women may be trained for this work); a maintenance department; scheduling, routing, and planning sections; and all the forms and paperwork necessary to control production and furnish cost figures or other desired information.

In addition to machines donated or

Foundry learners at the Cleveland Trade School receive instruction in bench, floor, and machine molding. The two men in the foreground are learning to operate a roll-over machine and a jolt squeezer respectively. J. C. Goldie, supervisor, has two classes in foundry work, each consisting of 25 young men anxious to learn

There will be no lack of good "learner" material for welding jobs when Cleveland tackles its part of the national defense program. Since the first of the year, Cleveland industries have received approximately $50,000,000 of orders under the regular military appropriation, are expecting some $250,000,000 more. Ohio's share in the $10,000,000,000 defense program will be $1,086,000,000 under the allocation made by the Industries Planning Division of the War Department, and based on World War experience Cleveland may reasonably expect to get 30 percent of that amount



Training in Cleveland does not end with NYA and Board of Education programs. Warner & Swasey, to cite a notable example, had long had a program for teaching machine specialty trades to young men who have had fundamental shop courses in technical high schools, or equivalent shop experience. Learners from both NYA and Board of Education schools are being inducted into shop work here as they are ready and can be used. Already a number of young men have been accepted

loaned by industries for the use of the workers, more than 100 pieces of equipment were purchased — surface grinders, universal grinders, shapers, air compressors, arc and spot welders, power hacksaws, gas-fired hardening and annealing furnaces, hand milling machines, 20-in. motor-driven vertical drill presses, sheet metal machines, engine lathes, acetylene welders, and portable grinders of various types and makes.

Chief sources of personnel for the training groups are the WPA rolls, the young people in the NYA work, and men who are not on either list but who are registered with the Ohio Employment Service. When a man becomes unemployed, he registers with the Unemployment Insurance Compensation Commission; then he is sent to the Ohio Employment Service office where he is registered for a job. If he does not get a job within a specified time, he begins to receive unemployment checks. There has been, until recently, a constant stream of men into these offices.

From these registrants the Employment Service chooses men eligible for the training groups. These are in addition to those on WPA rolls. Before recommending men to the training centers, the employment office makes a careful check on the applicant's character, habits, previous record, and background.

Men from the WPA, if turned back by the training centers, may return to their projects, or if they prove unsatisfactory after starting the course they may be transferred back.

So far the men in charge of this work, including members of the Cleveland Personnel Association, have been gratified by the number and quality of WPA men who are taking the training. Many of them, intelligent and ambitious young men, are high school graduates who have never had a steady job. They stand up well both in intelligence tests and in the PLR (Probable Learning Ratio) test.

In general, the association has advised a common sense attitude in the selection of men, with no hard and fast rules regarding age, experience, and previous employment, unless unsatisfactory performance is indicated. All training agencies are using this general guide in selecting and training men—they must have the right attitude and good habits; they must display a special interest in mechanical trades; they must attend to business and "get somewhere" every day.

It is believed that this selection and training process will result in the men being "triple distilled" by the time they reach the employment office of an industrial plant, by reason of their careful selection, special interest, and fundamental training, and that they should make excellent "learner" material. They will know how to operate at least one type of machine and have a general groundwork of shop practice. The rough edges will be knocked off, and they should be able to turn out a good day's work within a reasonably short time.

Tangible results of the association's efforts up to date are the following:

1. An improved fact-gathering system which will reflect more quickly and accurately the employment picture from day to day.

2. Assistance in making Cleveland, one of the large cities in the country, a real training center for essential defense industries.

3. Assistance in coordinating the efforts of all agencies, so that no duplication of work will occur, and no one will be working at cross purposes; tying activities to the special needs of the hour.

4. Encouragement of the NYA to start classes, and procurement of a director of long and successful experience in industrial work.

5. Establishment of permanent contacts among agencies that will be increasingly helpful in carrying out the defense program.

The association has no intention of taking credit for the accomplishments of the several agencies who have done, and are doing, a splendid job for the national defense. The members are simply doing the part assigned to them to help in every way possible to clarify the situation and keep the agencies constantly informed with respect to manpower needs, and to suggest the most efficient methods of intensive training to the end that Cleveland's share of a big job may be well done.

No one claims the plan is perfect; it is an expedient created for an emergency, but the best answer to the criticism of those who are not in sympathy with the movement is: *The job is being done, and practical results are being accomplished.*

Let Employees Find the Answers

Given chance to solve production problems, they willingly contribute their thinking and make job analyses to improve quality control and smooth out grievances

F. H. STOWITTS
Production Manager, Michigan Carton Company
Battle Creek, Mich.

BECAUSE OUR CUSTOMERS were requiring increasingly high standards of quality, we ran into a quality control problem—too many defective cartons were getting by our inspectors. The trouble was located in one of our most important operations, that of gluing, sorting, and packing, where cartons spoiled in printing, cutting, and gluing processes, or by defective board, must be sorted out and rejected.

In the inspection at this point, many different brands of the same size and colors, but different printing, are run over the same glue machines in rapid succession. Special alertness is required to keep these separate and to label and bundle correctly.

Two years ago, some solution became imperative. Of course, attempts had been made before that time, but they had not been entirely successful. As an example, the foreman specified that the machine must be clear before starting a different carton through, but the necessity of stopping the machines while the same color combination was going through tended to nullify the effect of this rule. A stopped machine did not always indicate a change, and attention consequently lagged, with mixed bundles the result.

Job Analysis Needed

Among other things, a careful job analysis seemed to be called for, which would result in precise definition of duties and responsibilities of each member of the gluing team, leaving nothing to fallible memory. If a job analysis only were involved there would be no point in telling this story, for the technique of such a study and its usefulness are too well known to need repetition. But the way in which this study was made we believe to be unique—the glue room workers made the study themselves. The psychology of asking an individual to define his own responsibility is not the least important part of this venture.

This study could have been made by the management more quickly, for it covered a period of ten weeks, but it was decided to place the responsibility with the employees since good results had been secured from employees' committees in such other matters as recreation, suggestions, and safety. Then too, if management did the job, the constructive thinking and cooperation of employees would not be a part of the

Mr. Stowitts has been in the printing business all his life, and manufacturing cartons for the last 30 years. Starting as a pressman, he has held responsible positions in practically every department of carton manufacture. Always interested in the improvement of printing personnel and methods, he was an early president of the Printing Craftsmen's Guild in Southern Michigan. He has been active in community affairs, serving as president of the Community Fund, Kiwanis, Battle Creek Engineers Club, and many terms as treasurer of the local school board

JOB ANALYSIS

Name of Job **FEEDING** *Department* **GLUE ROOM** **1-25-39**

Duties	What Employee Must Know	Source of Information
STARTING UP		
1. Inspect job carefully to know exactly what is running.	1. Should be familiar with various jobs run.	1. Experience as wrapper
2. Check the load for mixed cartons.	2. Should know about different colors and cuts on jobs, so as to be on guard.	2. Ditto.
3. Check with foreman (A.M.) to be sure what job is starting up.		3. Experience, foreman.
4. Make sure glue is O. K.	4. How it should be.	4. Experience, foreman.
RUNNING		
1. Remove the tag from each new load before beginning to feed it, and take the tag at once to the girls inspecting.	1. Where to find load tag.	1. Foreman.
2. Crack cartons before feeding.	2. How and why.	2. Foreman.
3. Notify the machine man at once when the machine is not operating properly.	3. When machine is not operating right.	3. Inspectors, observation, experience.
CHANGING		
1. Make sure that the other help knows when you make a change.	1. That mix-ups occur if great caution is not exercised.	1. Foreman.
2. Send a *change* card through.		
3. Hold the new job until the chute is clear.		
BALL-UPS		
1. Make sure that all dry cartons are out of the machine before beginning feeding again.	1. When they are out.	1. Observation, inspectors.
FINISHING UP		
1. Make out machine report showing production and running time.	1. How to write legibly.	
2. Pick up girl's spoilage cards and turn in with this report.	2. How to charge delays. How time is indicated on the report.	2. Foreman.
3. Report time accurately.		

GENERAL RESPONSIBILITIES

1. Keep cartons running through the machine.
2. Look out for mixed loads and changes.

Typical study made by job analysis committee is this analysis of glue machine feeding

plan; it would not be their idea and they would not have the same interest in the success of the plan.

Occasionally during the past years the superintendent called employees in a department together to consult with them regarding routine departmental matters. This was not on a formal, organized basis, and the results were not altogether satisfactory due to reticence in talking critically with supervision present.

The ground was thus prepared for bringing production problems to employees' attention, but experience indicated that best results would be secured in this particular problem if the workers enjoyed considerable freedom to criticize and to suggest.

Everybody's Ideas Welcome

A committee of nine who had the respect and confidence of their fellow workers was selected from the glue room employees. Publicity was given to this move in the plant papers, and all employees in the department were encouraged to contribute their ideas to committee members.

Two shifts are in operation: one from 6 a.m. to 12 noon, the other from 12 noon to 6 p.m. The committee meeting time was from 11:30 a.m. to 12.30 p.m., and included in its membership workers from both shifts. Extra compensation was paid for the additional time involved. At the first meeting, the superintendent outlined the situation, which was familiar to them, and presided while the nine workers elected their own chairman.

This committee met once each week for a period of ten weeks. The assistant personnel director, the only man-

The glue room from the packaging end of the machines. All jobs here—feeding, inspecting, sorting, and wrapping—were analyzed

This is the glue room job analysis committee which in a series of ten weekly meetings found the answers to production problems

agement representative, acted as secretary and coordinator for the group. He was careful not to usurp the functions of the chairman. It was impressed upon the group that they were the experts and the secretary was present only for the purpose of taking notes of the suggestions. The secretary talked over with the chairman the things that should be considered in each meeting. Copies of the notes taken were given to each committee member after the meeting, and a copy was posted on the bulletin board in the glue room to inform all employees what was being done.

A Job a Meeting

The order of meetings followed the sequence of tasks in the gluing operation. One meeting was devoted to the contribution which the trucker, who delivers cut cartons from the cutting room, could make to avoid mix-ups. The committee realized from the detailed experience of the members that the position in which the stock was left in the glue room and the notations on the truck tickets affected the problem.

The same procedure was used for the five positions of the operators on the machine. Several meetings were devoted to the feeder who feeds the flat cartons into the machine. Inspection, sorting, and wrapping followed.

It was found that planning the subjects for the meeting in advance and the asking of questions by the secretary resulted in an outline of the difficulties involved and workable suggestions as to correcting them. As the meetings continued, the solution to the problems began to take shape. The duties of each job were defined and the employee given the necessary information regarding standards to be maintained. An example of one of the job analyses is shown here.

This analysis was mimeographed and a copy given to each glue room employee. A letter was attached calling attention to the importance of the problem, and giving the committee's suggestions as to the standard duties and responsibilities for each job.

The results have been gratifying, and complaints of mix-ups and other problems have been practically eliminated since the job analysis was completed. In fact, the cooperation developed in this instance was so worthwhile that the procedure was adopted to meet a difficulty in another department, the cutting room. Here the trouble was not mix-ups, but a change to a six-hour plan of working hours, and the shift in duties between press operators and helpers which resulted in misunderstandings. Consequently, efficiency had dropped to such an extent that unsatisfactory conditions existed. When management agreed to use the same procedure in making a job analysis of cutting that had been used in gluing, efficiency increased even before the study was begun.

Grievances Disappear

The reaction of the cutting room employee is sufficient evidence of the confidence engendered by this method of attack. Members of the committee have stated with considerable pride that ideas which they proposed at the meetings have worked out successfully in preventing mix-ups, and foremen have reported cooperation is much more fully given than before. Grievances from the cutting room have largely disappeared.

This experience has convinced us that our workers, when a way is provided and they are convinced that their ideas are desired and will be respected, are anxious and willing to contribute their thinking to the solution of operating problems.

Conveyors Solve the Problem

In a five-story storage and shipping building, conveyors connected by spiral chutes prove the better way to sort and handle several thousand cartons of paint cans daily

E. O. MERKEL

General Stock Keeper, Eastern Division, The Sherwin-Williams Company
Newark, N. J.

A SERIES OF BELT CONVEYORS tied together by chutes proved to be the most economical solution of the troublesome problem involved in the sorting out and handling of several thousand cartons of paint cans daily from production to stock and to the shipping department. The number of cartons to be handled was not of particular consequence. What mattered most was the fact that our standard line of products contains thousands of different kinds of finishing materials. They are put up in cans ranging from 1-gal. to ¼-pt. capacity. Hence, we have a great many different items to handle. And economy in handling from production to shipping is just as important as efficiency in production.

Little would be gained by telling how we used to handle finished products. It is enough to say that we outgrew the old methods, and had to work out better ones to replace them.

Since the production departments needed more room our first move was to put up a new building, five stories high, 60 feet wide and 160 feet long, to be used exclusively for stock keeping and shipping.

The first floor is given over entirely to the shipping department. On each of the other floors there is a belt conveyor approximately 140 feet long, designed to handle cartons on both the top and bottom strands. Each conveyor is placed directly under the one above it. At both ends of the conveyors on the four upper floors there is a spiral chute leading to the conveyor on the floor below.

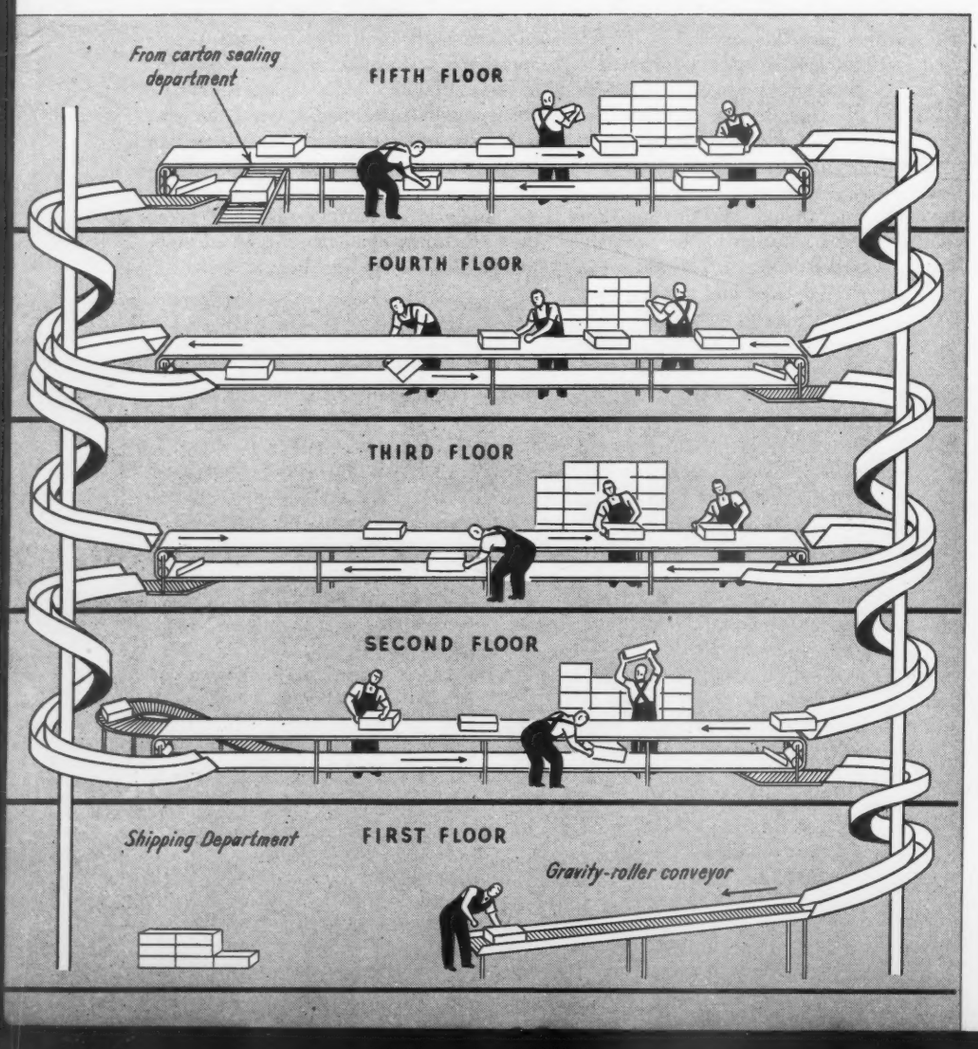
The shipping department on the first floor contains a 75-ft. section of gravity roller conveyor which is fed by a spiral chute leading from one end of the second-floor belt conveyor.

General arrangement of the conveyors on the five floors of the shipping building, and their relation to each other, will be seen from the diagram. Note that the chute that takes cartons from the top strand of the fifth-floor conveyor discharges them onto the top strand of the fourth floor conveyor. From this conveyor they are then delivered to the top strand of the third-floor conveyor, and so on.

Likewise, cartons on the bottom strand of any conveyor are discharged by a chute onto the bottom strand of the conveyor on the floor below.

To get a clear picture of how this system of conveyors works in practice, it will be necessary to go to the carton-sealing department, located on the second floor of another building. These two buildings are separated by a 75-ft. street, through the plant yard.

Conveyors in the shipping building are placed one above the other. One set of spiral chutes connects top strands of all conveyors, while another connects all bottom strands

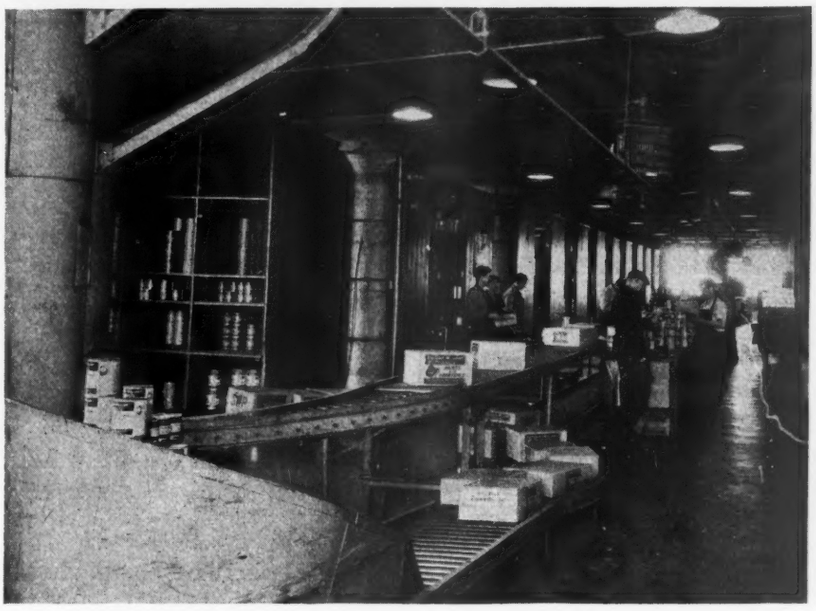


Cartons Climb to Fifth Floor

Cans received from the filling department on the floor above are put through the labeling machines and then placed in cardboard shipping cartons. After leaving the sealing machines the cartons are carried up to about the level of the ceiling on a 25-ft. section of belt conveyor, sent around a U-turn, and discharged onto a 100-ft. section of belt conveyor suspended from the ceiling. On this conveyor the cartons travel opposite, of course, to their direction in passing through the sealing machines. It discharges the cartons onto another belt approximately 100 feet long which carries them up to the fifth floor of the shipping building, across the street, and discharges them onto the top strand of the belt conveyor on that floor.

Cartons delivered to the fifth floor

All cartons are delivered to the belt conveyor on the fifth floor. Rollers in foreground lead to chute discharging onto bottom strand of conveyor on the floor below



Cartons on bottom strand of second-floor conveyor go down chute at the other end to shipping department. Those on top strand are automatically transferred to the bottom

conveyor may contain cans of any size from 1-gal. to ¼-pt. capacity, filled with any kind or color of paint in our standard line. On the fifth floor, however, only 1-gal. cans are kept in stock. Hence, as the cartons pass along the conveyor, men stationed on both sides of it pick off all cartons containing 1-gal. cans and stack them according to the kind and color of paint in them. Cartons which are not picked off simply go to the end of the conveyor and down the chute to the top strand of the fourth-floor conveyor.

While this is going on a steady stream of orders is coming up from the shipping department for cartons of 1-gal. cans. Order pickers take them from stock, stencil the customer's name and address on them, and then place them on the bottom strand of the conveyor belt. It carries them to the chute that discharges them onto the bottom strand of the fourth-floor conveyor, from which they pass in turn to the bottom strands of the third and second-floor conveyors and then onto the gravity roller section in the shipping department on the first floor.

In other words, after a carton has been placed on the bottom strand of the fifth-floor conveyor no further manual handling is required until it reaches the shipping department.

Substantially the same procedure is followed on the other three floors. That is, all cartons that were not picked off on the fifth floor now pass along on the top strand of the belt on the fourth floor. Stock keepers pick off all cartons containing half-gallon and quart cans, and stack them according to size of can and kind and color of paint. Cartons called for on shipping orders are picked out, stenciled, and placed on the bottom strand of the belt, after which they make their way automatically to the shipping department.

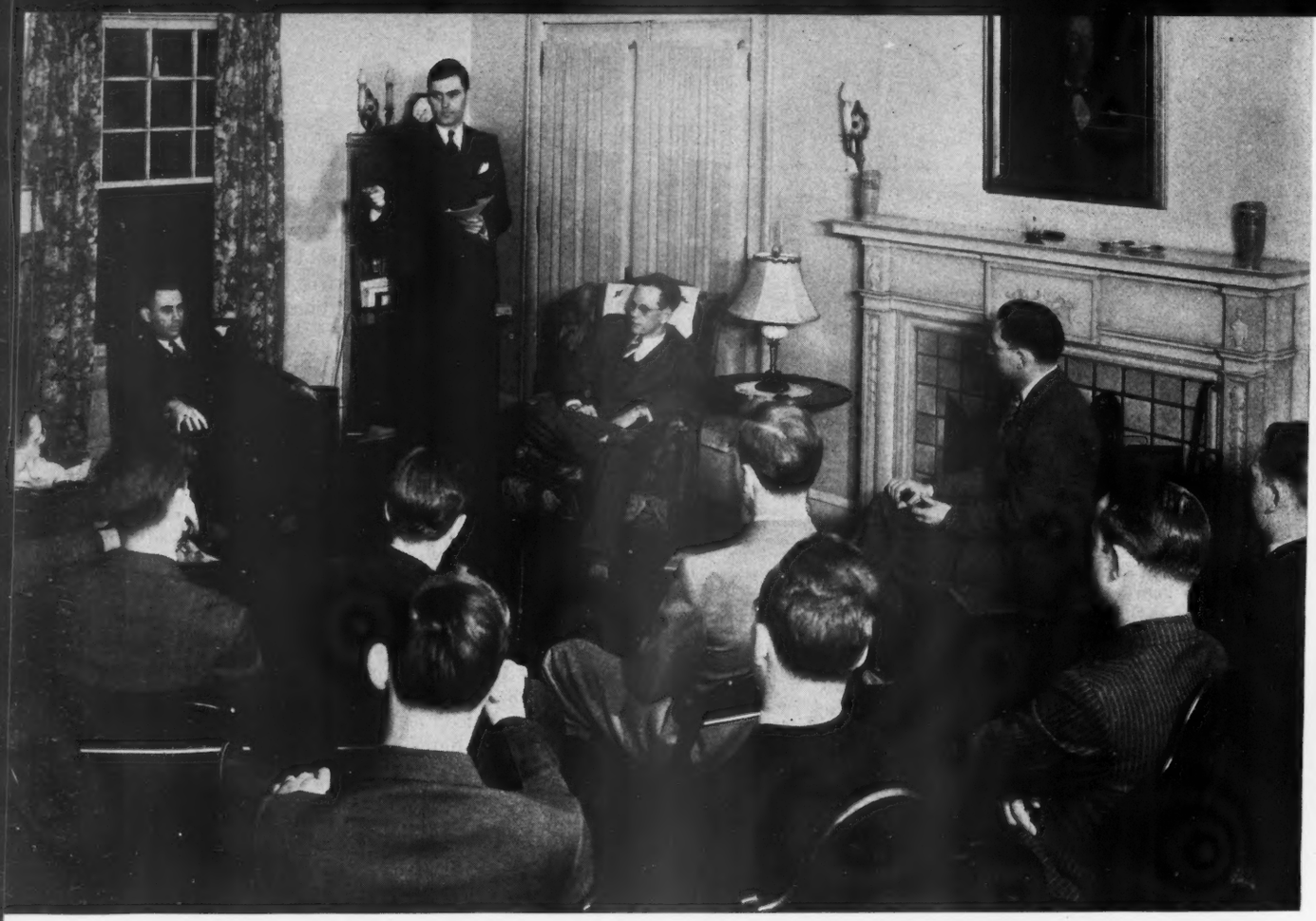
Duplicate Conveyors

On the third floor cartons containing pint, half-pint, and quarter-pint cans of paint, and all clear enamels, are stored. The conveyor is a duplicate of those on the fourth and third floors and performs the same functions, previously described.

In all essential respects, as well as functions, the belt conveyor on the second floor is the same as those on the floors above. The bottom strand receives cartons coming down the chute from the bottom strand of the conveyor above and discharges them into the chute leading to the gravity roller section in the shipping department. Likewise, the top strand is fed from the chute leading

(Continued on page 148)

In the shipping department cartons coming from the floors above run out on a gravity roller conveyor, from which they are picked off and properly assembled for shipment



One of the evening's speakers emphasizes a point. At his right sits Mr. Baker and at his left the secretary for the evening

To Get Ahead, They Learn to Talk

Young engineers learn the art of speaking in a self-help class sponsored by their chief

A YOUNG MAN employed by John Baker, Chief Engineer of The Timken Roller Bearing Company's Rock Bit Division, had an opportunity for promotion to a better job. But when he was interviewed by his prospective employer the young fellow became so excited he was unable to express himself clearly, and, as a result, lost his opportunity for promotion. Mr. Baker was greatly disturbed because he knew that the chap had plenty of ability and initiative; so he told him to come to his home for a bit of instruction on poise and self-confidence. Baker suggested that some of the other fellows in the plant might be interested, too.

The first evening 11 boys showed up and the meeting was conducted in the manner of a professional technical meeting, each addressing the other as "Mister." Two of the boys gave 10-min. impromptu speeches and four gave 5-min. talks, all of which were pathetic examples of rhetoric and public speaking. The next meeting found 14 boys present. The original speakers who had attended the first meeting had improved so noticeably that Mr. Baker questioned them and learned that they had, with the assistance of friends, applied themselves to the task of improving poise, grammar, and other attributes of the public speaker.

Meetings Once a Month

The class now meets regularly each month with an ever increasing membership which has agreed that "the purpose of all these meetings shall be to help us to learn to speak clearly and easily, both formally and informally, on subjects that may be prepared in advance or discussed impromptu. That attendance shall be purely voluntary, entirely friendly, and wholeheartedly cooperative."

From the outset the group has dispensed entirely with the social angle and has placed all emphasis on getting down to business. There are no dues and no expenditures. The favorable results have been far beyond expectations of the most optimistic members and observers. For example, during the last meeting one of the fellows who had been too timid to even attempt speaking a few months ago delivered a speech that would have done credit to a professional engineer. It was a model of conciseness and clarity, and was delivered with such poise and evident self-control that it was hard to believe that this fellow's public speaking experience had been limited to so short a period.

Possibilities for far reaching expansion of this self-help program were uncovered only recently when the man in charge of Timken apprentices offered to supply an audience for the self-help

(Continued on page 147)

Management Shorts

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

HANDLING AND MOTION ECONOMY

Fast Weighing Solves Scrap Handling Problem

SOURCE
Fairbanks, Morse & Company
Chicago

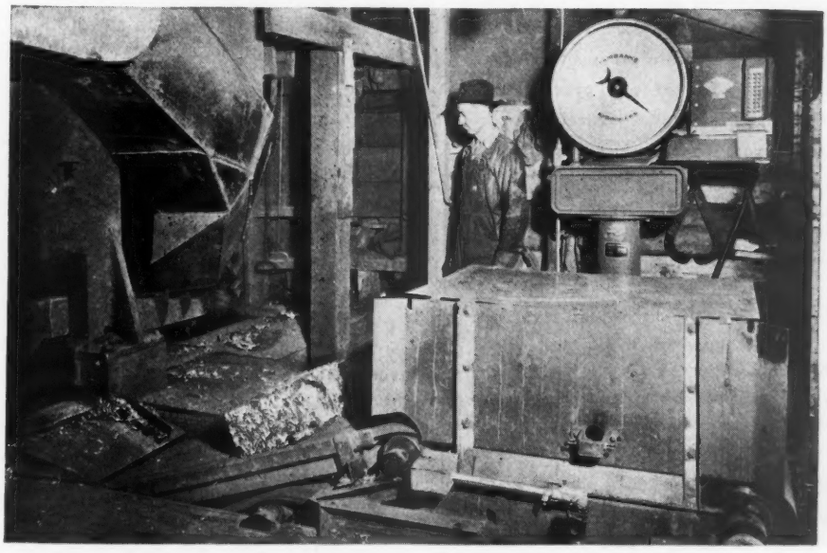
The handling of scrap metal that results from parts processing in the machine shop, is often a "headache" to many a plant superintendent. One manufacturing concern which has a lot of scrap tinplate to contend with has solved this problem in two steps.

First they put the scrap through a heating furnace where all the tin is reclaimed; second, the scrap is put through a shredder and then pressed into bales about 18x15 inches in size. Each bale is pressed under 300 tons pressure and weighs about 200 pounds. The bales of scrap then go back to the open hearth steel mills.

In handling this material, one of the most serious problems was that of weighing the bales. As the operators are paid on a tonnage basis, it was important that each bale be weighed quickly and accurately. A dial scale with printer, operated by means of photoelectric cell, finally turned the trick to everyone's satisfaction.

A section of roller conveyor is mounted on the scale platform, while an endless belt 9 feet long and 36 inches wide passes over the scale platform and underneath the scale box at a speed of about 12 feet per minute. As the bale comes from the press and drops onto the moving belt, it is carried across the scale platform. Then at the instant the bale passes over the center of the platform, it intercepts the beam from the photoelectric cell. This automatically trips the printing mechanism and prints the weight. The printing mechanism is set to weigh a bale of scrap metal about every 20 seconds, much better time than by our old method.

There is a housing over the scale platform, closed on two sides and at the top, to keep the shadows of the workmen who pass by from tripping the very sensitive photoelectric cell.



Weighing is an automatic process as belt carries scrap over scales from baling press

Special Handler Speeds Loading of Steel Sheets

E. H. TRICK, *San Antonio, Tex.*

To conserve warehouse space we store our galvanized corrugated sheets on end, leaning against the wall at a pitch of one inch per foot. Due to the narrow aisle, and the proximity of heavy machinery, we had a lot of trouble bringing the packs out to the truck loading wharf.

We solved our trouble with the device shown here. It consists of a light angle iron frame two feet wide by seven feet long, with rubber-tired wheels at one end. At a point about midway of the back of the frame is hinged a rectilinear frame of light angle iron, with rubber-tired casters at the corners of its bottom end. This rear bracket opens out and draws in much like the flying rung of those popular canvas-backed porch chairs we all use. It is controlled by $\frac{5}{16}$-in. steel cables that fasten to each corner at the caster, pass over a guiding sheave at the bottom of the main frame, and ascend to a drum made of $2\frac{1}{2}$-in. pipe which is back-geared 3 to 1 and operated by a 14-in. crank.

The gear and pinion are partially covered by a clevis-shaped shield in which

holes are drilled to fit a locking pin that hangs by a short chain nearby. This pin passes between the teeth of the pinion when in position and forms an effective lock, much better than a pawl.

The 6-in. front wheels are fitted with a lever-operated brake.

The device is rolled down the aisle in its elevated position at an inclination of one inch per foot, the packs of sheets are "walked" onto two projecting lugs at the bottom of the frame, and lie back in two cradles. The device is easily pushed out to the truck wharf in this upright position.

There the brake is set on the front wheels and the packs lowered by means of the crank, the hinged portion moving out behind on its casters until the packs are in an inclined position just right for picking up and pushing onto the waiting truck. The rear end of the frame is fitted with a roller so that the overhanging ends of long packs may be dragged over it without the binder catching as they are being pushed forward into the truck backed up to loading platform.

One warehouseman and the truck driver can easily load packs of any commercial length.

PRODUCTION PLANNING AND CONTROL

Another Slide Rule Technique for Time Studies

LOUIS REASOR, *Standards Department*
International Nickel Company, Inc.
Huntington, W. Va.

In the June issue John Lundvall described on page 164 a short-cut slide rule method for computing time studies. The method as outlined is fine with one exception, viz, one has to remember or keep at hand the constants for the various relaxation factors. An improvement on Mr. Lundvall's method would be to mark an auxiliary scale on the slide rule for the relaxation factor covering personal and fatigue allowance. To do this, use the *DF* and *CF* scales if a "Merchant's" slide rule is used. For marking a regular "Mannheim" rule, use the *A* and *B* scales instead of the *DF* and *CF*, respectively.

If times are taken in seconds, set *6* (*CF* scale) opposite *110* (*DF* scale). Under *6 (DF)* scratch a line on the slide part of the rule. This is the setting for 10 percent relaxation. Move the *6* (*CF*) opposite *120* (*DF*), and under *6* (*DF*) scratch another line on the slide. This is the setting for 20 percent relaxation.

Continue setting the *6* (*CF*) opposite successive relaxation ratings plus *100* on the *DF* scale, marking these settings under the *6* (*DF*) on the slide. After a convenient range of relaxation ratings has been marked on the slide, all one has to do to convert a given time (in seconds), a relaxation rating, and a performance rating (with 60 as normal) into standard minutes is to:

1. Set the proper relaxation rating setting (as scratched on the slide) opposite the performance rating as represented by the regular *DF* scale.
2. Opposite the time (in seconds) as represented by the regular *CF* scale, read the standard minutes on the *DF* scale.

If times are taken in tenths of a minute, proceed exactly as outlined above with one exception, viz, use the index *1* on the *CF* scale instead of the *6* to set opposite *110* on the *DF* scale. As before, under *6* (*DF*) on the slide, rule a line which will again represent a 10 percent relaxation rating. Continue setting the *CF* index opposite successive relaxation ratings plus 100 on the *DF* scale, and mark these settings under the *6* (*DF*) on the slide. The final scale, as scratched on the slide, is used as described above.

Just a hint in scratching markings on a slide rule. We have found that a sharp needle drawn along a steel straight edge makes the best marking. Scratch deep enough so that red ink placed in the marking will give a well defined line. Rub off with an eraser any excess ink which has spread to the face of the rule.

•

The Containers Count the Parts

J. M. ROBINS
Yankee Metal Products Corporation
Norwalk, Conn.

In our drive to eliminate production bottlenecks and cut down handling time, we found that since lathe operators were working on a bonus system, it was necessary to get an accurate count on the parts produced, and work was being trucked down to a counting scale in the stockroom for counting, back again to the lathe, back once more to the stockroom for another counting, and then up into the polishing room. Inasmuch as the counting scale was needed in the

(Continued on page 156)

Management, How Good Is Your Control?

Ask yourself these questions to check up

1. PLANNING

1. How is your planning? Is it thorough? Is it too detailed? Is it too sketchy?
2. Do you revise your plans frequently to meet changes in situation?
3. What phases of your work could stand more careful planning?
4. Do you follow a short-range plan and a long-range plan? Continually? Are they kept simple? Practical? Are they producing good results? How can they be improved? Can your application of them be improved?
5. Do you appreciate the importance and value to you of good planning?
6. Are you always careful to follow up your planning with productive action?
7. How far do you plan ahead? Is it far enough? Too far to be practical?
8. Do you appreciate the relationship between planning and control?
9. Are your plans coordinated with those of your superiors? Are your men generally familiar with your objectives?
10. What activities under your control can be improved by more careful planning? Have you shown them how to plan? Do you do any planning for them that they should really do for themselves?
11. Are your plans specific?
12. Are your plans often interrupted by factors beyond your control? Can you eliminate this? What factors interrupt your planning most often? What have you done about them?
13. Are your short and long-range plans supplemented by written memos? Do you revise them periodically as changing conditions warrant?

Next month: Setting Up Machines

Prepared by HARDING PALMER, *Industrial Engineer*
Lockheed Aircraft Corporation, Burbank, Calif.

MAINTENANCE SERVICES

SELECTION

INSTALLATION

INSPECTION

UPKEEP

ORGANIZATION

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FACTORY MANAGEMENT and MAINTENANCE

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

EDITORIALS

L. C. MORROW . . . *Editor*

Maintenance Has Answers for Many Production Problems

MUCH WILL BE HEARD about bottlenecks in the days to come. What is meant, of course, is some vital point or process where any failure of production to flow along smoothly and at the proper rate results in more or less serious disruption of preceding and succeeding operations. Lucky indeed, and rare too, is the plant that does not have one or more spots where delays or trouble are unusually costly.

In many instances the maintenance department can do a great deal to widen these bottlenecks, so to speak.

Instances are known, for example, where raising the level or quality of lighting at machines or workplaces where it was deficient has increased production so much that all danger of serious tie-ups was averted.

Raising line voltage to its proper value may increase the output of electrically heated ovens or furnaces sufficiently to take them out of the bottleneck class.

Again, providing means of accurately controlling the speed of certain machines or making wider ranges of speed possible may be all that is needed to step up production or increase quality of output to a marked degree, and thus reduce the danger of a jam at these points.

Different materials handling methods or equipment may be the answer to congestion and tie-ups that cut down output and boost costs.

The solution of many of production's troublesome problems is to be found in the maintenance department.

Be Ready for Emergencies You Can't Prevent

A SIGNIFICANT MEASURE of the efficiency of any maintenance department is the amount of trouble it avoids by frequent inspection, proper upkeep, and all those activities which are broadly termed preventive maintenance.

Of equal significance and value, but more likely to be overlooked, is the ability to restore service in the minimum possible time after breakdowns or trouble.

A great deal can be done to forestall failures of equipment and other mishaps, but they can hardly be avoided altogether. Hence the need for adequate preparation to clear up trouble as quickly as possible and get the wheels turning again. To do this requires carefully planned preparedness in several directions.

One essential is a sufficient force of men who know their business. They must have available all tools and equipment needed in handling emergency work promptly and properly. Both men and equipment must be so organized and disposed that they can be swung into action whenever and wherever trouble develops, with the minimum delay.

Detailed plans, carefully worked out in advance, may well be of inestimable help in meeting serious emergencies in which time spent in deciding what to do might better be devoted to constructive action.

There must also be an adequate stock of spare units and parts in first-class condition and quickly available.

Emergencies that are anticipated and planned for lose much of their power to interrupt production and pile up losses. It is clearly the duty of maintenance to prevent them in so far as possible. But maintenance also bears the responsibility of being fully ready to meet them at any time or place.

Let Enclosed Motors Keep Maintenance Costs Low

OPERATING TWO OR THREE SHIFTS, instead of one, is a simple way of increasing output that will undoubtedly be adopted by many plants as orders pile up. Such an expedient may be a boon to the production department, but it tends to complicate matters for maintenance.

Longer hours of operation inevitably increase wear and tear on equipment, and thus make increased attention necessary. They bring also greater difficulty in finding opportunities for doing the necessary work, when machines are idle. Under these circumstances anything that can be done to reduce the amount of maintenance attention required is well worth thinking about. Enclosed motors offer such an opportunity.

Ordinary open-type motors need close attention when they are subjected to coolant, cast-iron dust or chips, excessive amounts of dust, and other harmful agents. Windings must be kept clean and dry, and the ventilating ducts open. The penalty for neglect to do these things is costly delays and excessive repair expense, while the cost of doing them may be unpleasantly high.

In this dilemma it is good policy to use equipment that is less affected by adverse conditions and therefore requires less attention. The higher first cost of a totally enclosed, fan-cooled motor, as compared with that of a standard open type, may easily be repaid within a short time. One rewind of the open type will go a long way toward making up the difference.

We Fight Fire With Gas

Because it is best adapted to meet the serious hazards involved in working under high temperatures with the flammable liquids used in making wax, lacquer, and paint

JAMES COLLIER

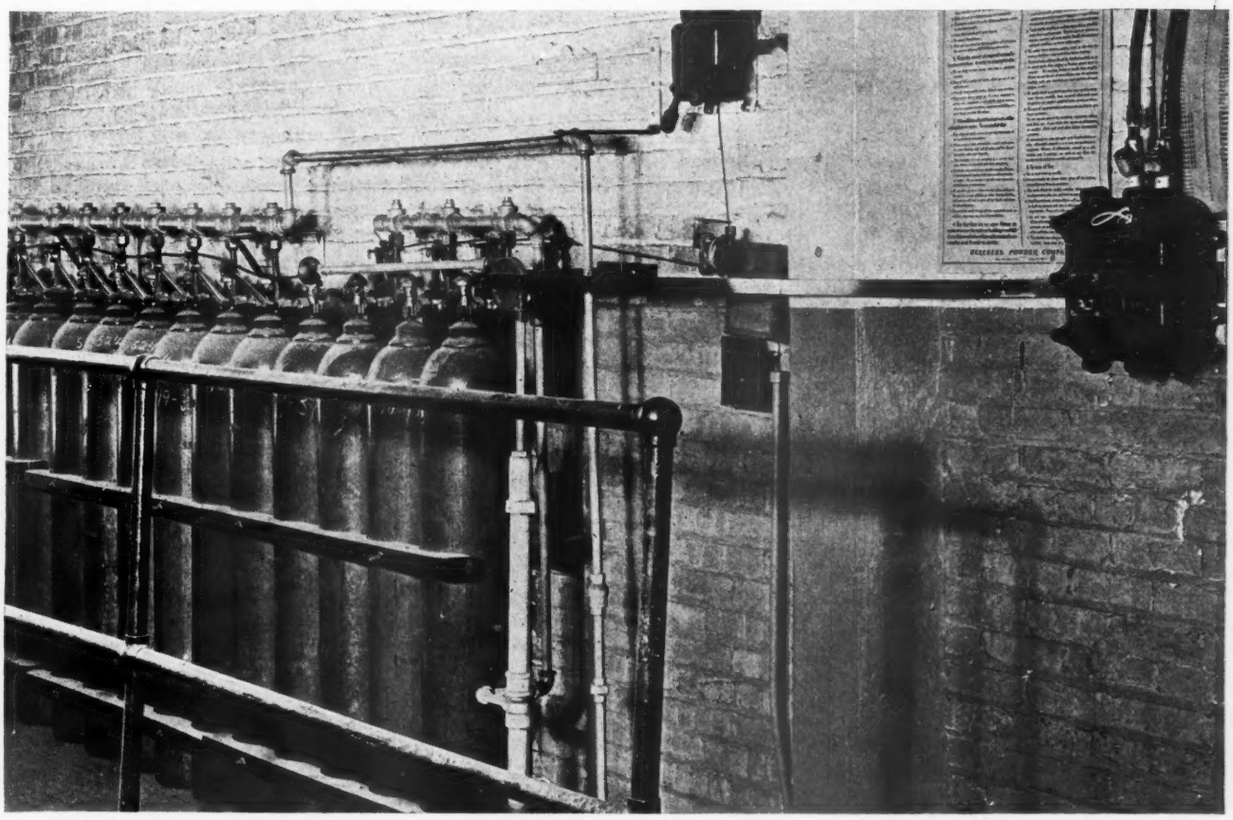
Factory Manager, S. C. Johnson & Son, Inc., Racine, Wis.

ANYONE WHO HAS WORKED with benzol, alcohol, naphtha, and lacquer thinner knows what difficult problems in fire protection these flammable liquids present—especially when they must be stored, pumped, and processed under heat—because their flash points range as low as 17 degrees below zero Fahrenheit. These materials are widely used in the manufacture of our line of products—paints, lacquers, and waxes.

Long ago we came to the conclusion that extraordinary methods of fire protection would be necessary, because of the unusual hazard involved in working with low-flash-point liquids at high temperatures, and in extremely large quantities.

Our most serious hazard, from the standpoint of severity of a possible fire, was in our lacquer department. Here nitrocellulose is put in solution, using large quantities of lacquer thinner. Many of the operations involve the use of heated kettles and agitators. These operations are carried on in a medium-sized room, which suggested the possibility of flooding it with carbon dioxide gas in the event of fire.

Such gas-flooding systems were first used in cargo spaces of merchant ships, and while the hazards there usually involve carbonaceous materials instead of flammable liquids, it has been proved that the discharge of several hundred pounds of gas immediately extinguishes all flame without damage to any of the contents of the enclosure. This latter fact was especially important to us, because contamination of large batches of lacquer and long shutdowns for



Thirteen cylinders of CO_2 protect the lacquer department. Connected through a manifold to a piping system, all cylinders discharge gas simultaneously when actuators in lacquer department respond to fast temperature rise. At right, auxiliary manual control

Small mixing tanks in the dye department are protected by gas discharge horns above them. On large tanks discharge horns go through the covers, so as to flood the tanks

cleaning up would cause sizable losses in addition to the fire damage.

Another factor was the ability of carbon dioxide gas and snow to penetrate past the many obstructions that would stand in the path of any liquid extinguishing agent used in this room.

Planned for Flooding

After extensive tests with carbon dioxide gas on small quantities of burning lacquer and lacquer thinner, we planned a system for complete flooding of our lacquer department. This system is built around thirteen 50-pound-capacity cylinders containing liquid carbon dioxide under a pressure of 850 pounds per square inch at 70 degrees Fahrenheit. These cylinders are connected through a manifold to a simple piping system having shielded discharge nozzles located near the hazard points, and pointing downward.

The gas is discharged simultaneously through all of these outlet nozzles, and is thus distributed uniformly throughout the room within a few seconds. The contents of these thirteen cylinders, when released, reduces the oxygen content of the air in the entire room from its normal 21 percent to approximately 14 percent, at which point none of the flammable liquids in the room can burn.

Operation of this system is completely automatic. The gas release mechanism is connected by small-bore tubing to actuators located on the ceiling. Any increase in temperature that is more rapid than is normally experienced from weather changes or processing operations compresses the air in this sensitive detecting system. The compressing action on a diaphragm operates the gas release valve, flooding the entire room with gas. There is also an auxiliary manual control which is located outside of the room itself.

Because the windows and doors in this room would allow the gas to escape, a method of automatic closing was devised. Discharge of the gas through the pipes withdraws pins that hold the windows open; therefore they immediately swing shut as soon as the system goes into operation. Leakage of the gas from the room is thus prevented and the oxygen content kept below the combustion point until the fire is out and ventilation has been resumed.

A hook-up with the motor starters in the room also was devised. Discharge of the gas opens these switches and stops the motors, thus cutting off the ventilating fans and shutting down operations.

Another carbon dioxide system was installed for the protection of our dye department and the transformer room. In the former department there is a benzol and alcohol hazard, and again flooding of the room was deemed advisable. To protect these two rooms a battery of fifteen 50-pound-capacity cylinders was installed with automatic directional valves to discharge the entire contents of the cylinders into either room in the event of fire.

The number of cylinders was determined by the size of the largest room and was based on the fact that these hazards require the use of 50 pounds of liquid carbon dioxide for every 1,000 cubic feet of contained air. This volume of gas is sufficient to extinguish any fire that may occur in the mixing tanks of the dye department, or in the transfer room through the burning of insulating oil from transformers or circuit breakers.

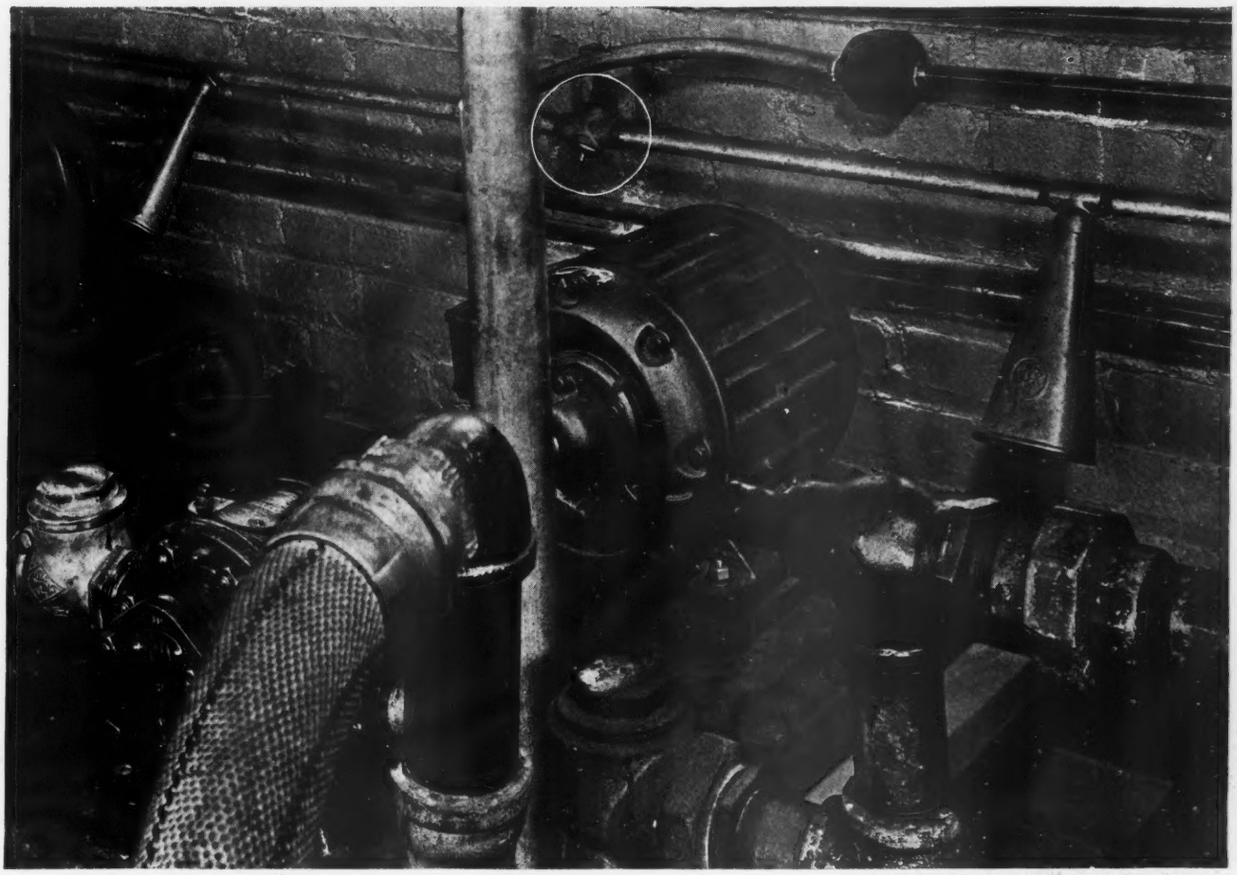
Out in 30 Seconds

The one fire that has occurred in the dye department since the installation of the system was extinguished within 30 seconds, and production was immediately resumed.

One other location that called for carbon dioxide protection was the pump house where the hazardous liquids mentioned previously are pumped from storage tanks to processing rooms. This building, which naturally contains a maze of pipes, hose lines, motors, and pumps, with many chances for fire through leakage, presented a hazard which could be controlled only by a gaseous extinguishing medium able to penetrate through the many obstructions and get to the source of the fire.

A battery of five 50-lb. cylinders is sufficient to bring the oxygen content of the entire pump house below the combustion point. The discharge horns were located so as to spread the clouds of gas over the motors and pumps should fire occur from leakage or breakage. Automatic window trips were included in the carbon dioxide pipe line, and the window chain rings are hooked over the pins in the pipe line in order to hold them open. The pins retract with the first discharge of the gas and the windows drop shut.

The four floors of our wax mixing department presented another fire-protection problem which we covered with a large battery of carbon dioxide



Photographs by courtesy of Walter Kidde & Company, Inc.

In the pump house gas discharge nozzles are placed close to motors and pumps. To hold windows open window chains are hooked over retracting pins (in circle) in the gas line. With first discharge of gas these pins retract and the windows automatically shut

cylinders. Although the cylinders are located in one bank the piping system is laid out so that the entire contents can be discharged into any one room where fire may occur, and completely flood it without affecting the other three floors. This is accomplished through the use of directional valves.

Full Automatic Operation

A reserve supply of gas is retained in the event that a fire might involve more than one floor of this building. Operation of the system is fully automatic, as is the case with all of the systems so far described, and auxiliary manual control is also provided as well as automatic door and window trips.

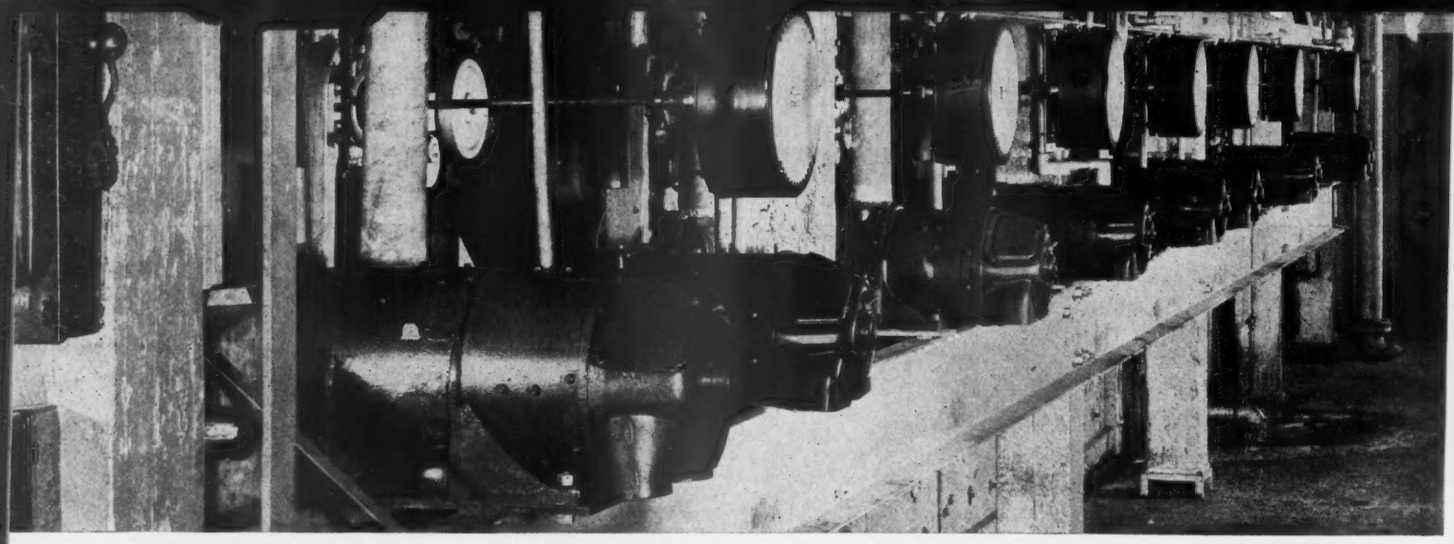
On the two lower floors of this building we have a can-filling operation which involves the heating and agitating of the liquid wax on the second floor, and a gravity-feed filling operation on the floor directly below. The hazard here, of course, is the electrically driven agitating equipment, which releases volatile fumes. We have protected each of these agitators with a one-cylinder carbon dioxide system which floods the agitator itself with gas in the event of fire, without discharging the main system. Operation of these cylinders is also fully automatic.

To supplement these fixed or stationary cylinder systems there are located at various strategic points throughout the plant several dozen hand-operated, portable carbon dioxide extinguishers. These extinguishers can be carried to the scene of the fire to discharge a blanket of gas through hoses and shielded discharge horns controlled by the operator. We have ten extinguishers ranging from 10- to 20-lb. capacity located where the more serious fires might break out, and also more than a dozen 2-lb. units located where smaller fires can occur. These smaller exinguishers, which are a little over a foot long and have trigger valves and pistol grips, can quickly be whipped into action to extinguish small blazes.

In the new administration building, too, there are several dozen carbon dioxide extinguishers of the portable type. These units, which are ordinarily thought of as being most effective on flammable liquid and electrical fires, are also considered to be very valuable for combating the average office building fire. Fires in storage rooms where carbonaceous materials are involved can be controlled by the gas, and the flames extinguished by dilution of the atmospheric oxygen. Embers remaining after smothering the flames can be extinguished by minute quantities of water.

They Walk and Wait

Our operating personnel has been carefully trained in firefighting technique, and the excellent fire record we have had in the past few years can be attributed both to this fact and to the completeness of our fire-protection apparatus. Each man knows exactly what to do when fire breaks out. For the most part, however, the only thing employees need to do is to walk to the nearest exit and wait for the gas to do its work.



Nips in open soaper of a textile finishing plant with variable-voltage range drive are driven by Reliance d.c. splashproof units

Room to Spare, With Gearmotors

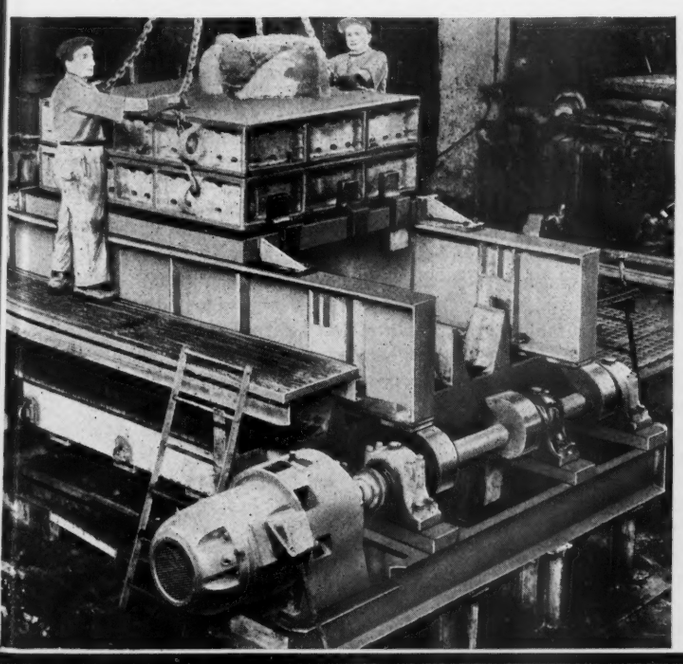
Here the problem of driving three machines for straightening pipe fittings was solved by installation of Westinghouse gearmotors

In a large rolling mill space was saved and efficiency increased by direct-connecting the rollers in a runout table to Falk units

Slow speed and plenty of power are required to drive agitators in a malt plant. Here Allis-Chalmers gearmotors provide both

Use of Master single-reduction units made it possible to provide these lathes with a compact drive operating on very close centers

In a foundry molds are raised and dropped 83 times a minute to remove sand. A General Electric gearmotor drives the machine



When You Install Capacitors

For power factor correction it's important to put them at the right places in the system. Several factors, discussed here, determine just where those places are

R. E. Marbury comes from Georgia. In 1917, after leaving the Georgia School of Technology, he cast his lot with Westinghouse. Later study at Carnegie Tech night school helped to round out his engineering education. Many years ago he developed a hearty dislike for wattless currents in distribution systems and since then he has waged a relentless war on them, with capacitors as his chief weapon

R. E. MARBURY

Switchgear Engineering Department
Westinghouse Electric & Manufacturing Company, East Pittsburgh

WITH ALTERNATING-CURRENT systems, the current for a given amount of true power depends upon the power factor of the load. If the loads are non-inductive, such as incandescent lighting, the current in the circuits will be minimum for a given amount of power. If they are highly inductive a greater current will flow. As loads become more inductive the cost of delivering a given amount of power over a given distribution system becomes higher.

The use of capacitors as a means of improving power factor is common today. Capacitors are available for all the standard voltages from 230 to 13,200, and in many different forms and types of assemblies. Selection and location of the capacitor for a given application, however, often requires considerable study of the conditions.

In most instances low power factor is due to the characteristics of the load. Induction motors, welders, transformers, and other apparatus utilizing electromagnetic fields or the equivalent draw wattless current over the system. There are instances, however, where the power factor is low because of the circuit reactance. Capacitors have been used in series with the load to cancel circuit reactance and reduce the reactive drop. In one plant the drop in the circuit was greater than the voltage delivered to the load and shunt capacitors were not the solution. This article, however, will discuss only the correction of power factor with shunt capacitors, since this is the usual type of installation.

They Make Bills Smaller

Where the loads are the chief cause of low power factor the capacitor may be connected in parallel with the load. It may be at the load, or at any point on the circuit. That portion of the circuit between the load and the capacitor receives no benefit, but the circuit between the capacitor and the source is benefited in the degree that wattless current is eliminated from it.

Benefits to be obtained from the use of capacitors include: First, direct savings in billing due to the maintenance of a higher power factor; second, savings that can be made in the plant.

The energy charge is usually based on the total kilowatt-hours consumed during the period, and varies directly with the amount consumed. There are a few rates where the demand charge may vary the energy rate sufficiently to make a low demand charge desirable.

Demand charges are determined by various methods. It is this portion of the rate structure which should be closely studied to determine what effect the power factor will have on the final billing.

Many demand charges are based solely on kilowatt demand with no penalty for low power factor; therefore it is obvious that correction of power factor will have no effect on billing.

On the other hand, many demand charges are based directly on the kilovolt-ampere demand, whereas others are based on the kilowatt demand multiplied by a varying amount based on the power factor. In such cases improving

the power factor will make a considerable reduction in the power bill.

Capacitors may be installed as one large bank, commonly referred to as group correction, or they may be scattered throughout the plant or placed directly on motors. The location is determined by the utilization of the capacitor. The lowest investment in relation to annual return is obtained when the capacitors are effectively used. Circuit length, voltage, resistance, and reactance must be considered, as well as the future addition of loads.

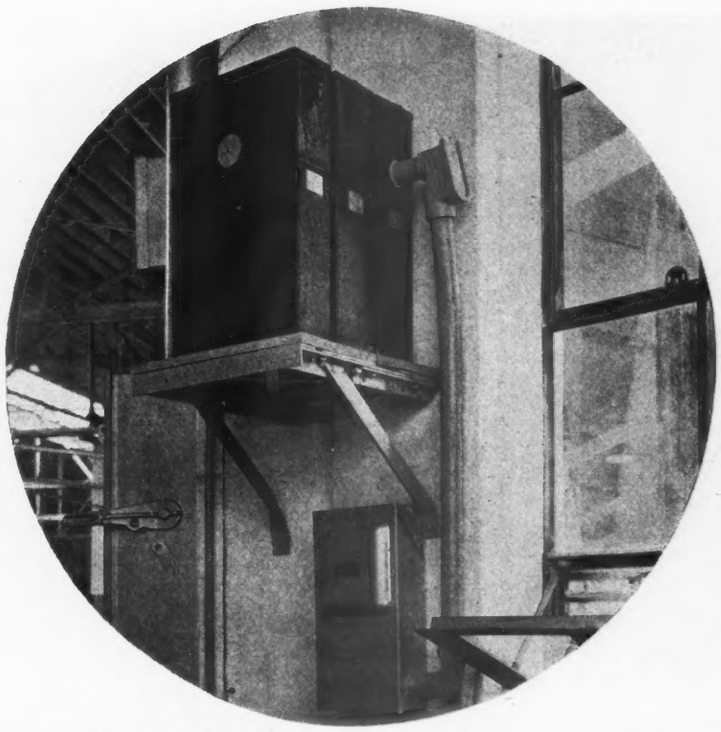
For example, assume that power comes in a plant at 2,300 volts and is distributed through several branch circuits at 2,300 volts to buildings *1*, *2*, and *3* where it is stepped down to 460 volts and supplied over short feeders to loads in the buildings. Nature of manufacturing operations is such that the division of the total load over these branch feeders varies considerably from time to time. Loads on the several branches reach their peak at different times, while the total load varies over a smaller range.

In this case a large bank of capacitors at the service entrance or substation will be the most economical because its size will depend on the average load rather than the sum of the average loads of the branches. The capacitor will correct the power factor of all of the branch circuits.

If separate capacitors were installed at the 460-volt side of the transformer in the outlying buildings the total kilovolt-ampere capacity would be considerably greater because each one would have to be large enough to take care of each of these loads. Assuming that these capacitors were left on continuously, regardless of local loads, the total capacity could be made the same as that of the main bank at the substation, but whatever advantage might be gained by moving the capacitors close to the load would be lost when building *1* capacitor is correcting the power factor of the load in building *2*, and so on. Also, whatever advantage is obtained by the removal of wattless current from the transformer in building *1* by this capacitor is lost when the capacitor in building *1* is supplying the wattless current for No. *2* building.

When to Split Capacity

On the other hand, if the operations in the several buildings are carried on simultaneously and the loads vary substantially together, the total capacity considered sufficient for the substation can profitably be split up and placed at these various buildings. Since 460-volt capacitors cost approximately the same as the 2,300-volt design they should be placed on the 460-volt side of the step-down transformers, thus relieving these transformers of the wattless currents.



Sometimes it's better to locate capacitors in small groups near motors, at various points. This 220-volt bank cost $368, saves about $145 per year

If the circuit voltage were 230 it is quite likely that the added cost of 230-volt capacitors would offset the gain and a 2,300-volt capacitor would show a greater return on the investment. Again, the present and future loads on the transformers might justify 230-volt correction, so as to avoid replacing the transformers with larger banks.

Assuming that the loads vary together in buildings *1*, *2*, and *3* and that it has been considered advisable to place the capacitors in these buildings and on the 460-volt circuits, the next question is whether they should be placed in one bank or further distributed in the building. Again it is a question of division of load. If the plant is a textile mill where the load division is relatively constant, the kilovolt-ampere capacity may be split up still further and placed on the circuits at various points near the loads, thus eliminating wattless current from still more of the wiring in the plant.

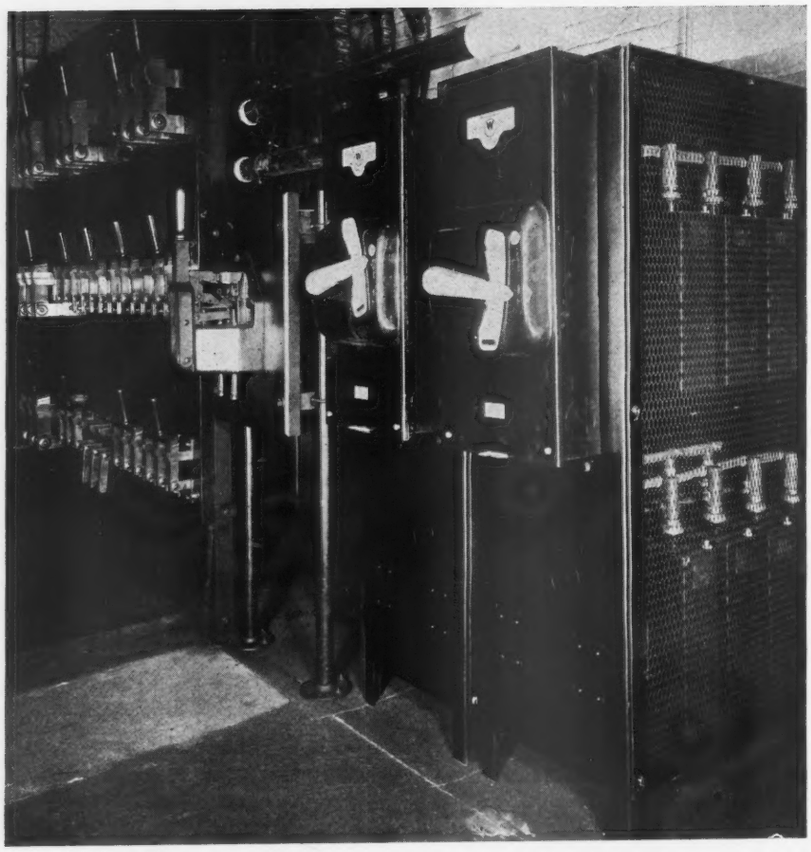
In the case of a machine shop having a wide variation in load distribution with time, it would obviously be better to leave the capacitors in one bank, situated at the load center.

It is unwise to divide corrective capacity to such an extent that the cost per kilovolt-ampere increases sufficiently to wipe out the gains. When capacitors are purchased in units of less than 5 kilovolt-amperes the cost per kilovolt-ampere increases rapidly. In addition, the installation cost per kilovolt-ampere increases rapidly when small units are involved. This latter charge can be held down, however, if the capacitors are connected on the motors so as to utilize the motor switches. Sometimes a group of motors is controlled through one switch, as in a textile mill. In this event a capacitor may be installed on the motor circuit to correct the power factor of the group and no extra switch is needed.

Where motors are at the end of long circuits individual motor installations work out quite well.

In some plants the load variations throughout the day or week are caused by the periodic operation of certain motors, rather than by changes in load on the motors. In such cases if the capacitors needed are connected directly across each motor, automatic variation of correction with load is accomplished in a very economical manner. Pump installations offer a good example of where each motor should be provided with its own correction.

Power rates in some communities encourage leaving the capacitor floating on the circuit at all times, regardless of



Duty of this capacitor installation at a load center is to remove wattless current from major circuits and improve voltage conditions. It cost $3,520, saves $229 a month

the local load conditions. This factor, of course, must be considered.

Where wide variations take place in the load, and group correction is employed, it is sometimes found desirable to switch portions of the capacitor bank on and off automatically. Before doing this the alternative of locating part of the correction directly on large loads should be considered because it provides an automatic change in corrective capacity at minimum cost.

Watch Interrupting Capacity

Aside from the conditions previously mentioned, many other factors enter into the selection of capacitors for industrial plant application.

The switching equipment should have sufficient interrupting capacity to clear a fault either in the capacitor or its accessories. The maximum short-circuit currents are encountered when the large group-type capacitor is installed at the power entrance. When these current values are high, say 40,000 amperes or more, the switching accessories become an important item. If the capacitors are moved out on the low-voltage circuits, less expensive switches may be used. These factors favor distributed and localized correction and should be taken into account.

The wave form of most power systems is relatively good. Capacitors are designed to operate on average and relatively poor wave forms, but there are limits which should not be exceeded. Standard capacitor designs are capable of operating at 135 percent of their rated kilovolt-amperes, such excess being due to over-voltage and bad wave form. When previous knowledge or tests indicate the possibility of high harmonic currents in a capacitor bank, it is well to place the units out on the circuits near the loads, or directly on the motors.

Experience has shown that as a capacitor is placed further out on the low-voltage circuits, the added line reactance and resistance limit the harmonic currents to the capacitor. Trouble-free operation has been obtained in this way on low-voltage installations where, if the capacitor has been installed as a large bank, it would have been necessary to install filters. To have included filters in the installations would have involved extra investment.

Experience has also shown that where wave forms were bad, no appreciable difficulty with harmonic currents in the capacitor was encountered during the day when the plant was loaded. At night during light load the wave form was bad. Usually there is no point in operating capacitors under conditions of light load in the plant.

When such conditions are anticipated it is advisable to place as much of the correction as possible directly on the loads, so that it will be obtained as needed. Such situations favor scattered correction even though it may not be warranted purely from the standpoint of circuit and transformer loading.

On and Off With the Water

Another condition that favors correction directly on the loads occurs when the plant is at the end of a long line, a considerable distance from the last voltage regulator. If the entire corrective effect were left on during very light loads, the voltage might be raised to an objectionable value. The capacitor may be manually or automatically switched off, of course, but the necessary reduction in capacity may be automatically accomplished if a substantial portion of the units are connected directly across the terminals of the motors that are shut down during light-load periods.

In certain industries special conditions are encountered, such as conducting deposits, hazardous fumes, explosive dusts, and high temperatures. Capacitors that are sealed against explosive or conducting dusts are available. Many are used in the textile industry where bad lint conditions are encountered. Those designed for operation in temperatures of 122 degrees F. or more, or where hazardous fumes are present, are special and more costly.

More Room Outdoors

Under such conditions it is more economical to use outdoor installations, either the housed type or the open-mounted type used by central stations on distribution circuits. Then a group installation may be favored over local correction, even though an inside installation near the manufacturing operations might offer some advantages. Space requirements may also favor outdoor or roof-mounted capacitor banks over indoor installations.

On 208-volt circuits it is more economical to use 460-volt capacitors with an autotransformer than to use 239-volt units, because of the reduced capacity at 208 volts.

No Dust, Better Health, More Output

No need now for a foundry to be the unhealthful place tradition would have it. Modern ventilation practice confines dust, fumes, and smoke and collects them at their source, then fills the building with fresh air

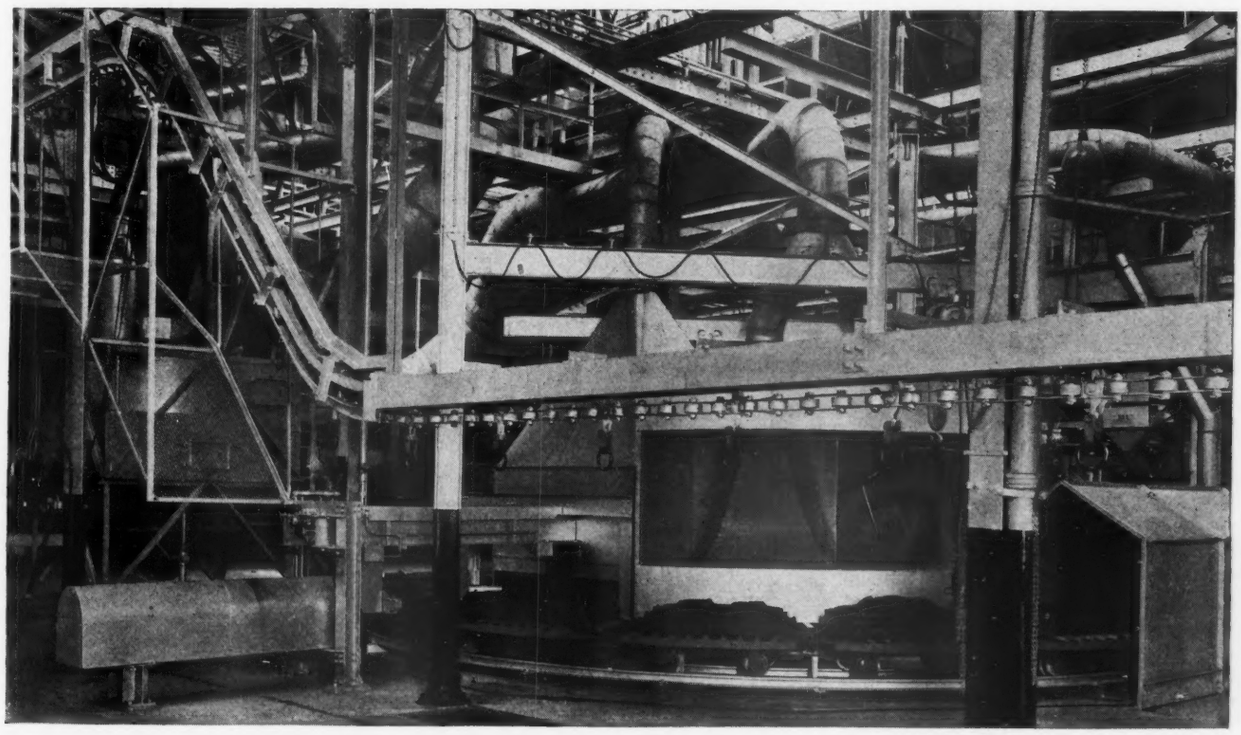
ARTHUR VAN VLISSINGEN, *Consulting Editor*

ANY FACTORY EXECUTIVE who believes he cannot afford to ventilate his plant might well look into modern foundry ventilation practice. Molding, cooling, and shake-out operations which formerly filled the air with heavy fumes and dense dust have been cared for so that only a small fraction of contamination now gets into the atmosphere. Admittedly, even the best and most modern of foundries fall short of a home at the seashore. But the air conditions that formerly were almost intolerable are today excellent by comparison.

One of the newest progressively designed foundries is that of the motor truck engine works of International Harvester Company at Indianapolis. Wherever air contamination can be prevented, the layout is designed to that end. The methods used fall into a few clearly defined groups:

1. Confining dust and smoke to vented chambers.
2. Collecting and disposing of contamination as close as possible to the point where it occurs.
3. Changing room air by natural and forced ventilation.
4. Removing contamination sources from interior spaces.
5. Forced draft to keep contamination away from worker's face and direct it into an exhaust duct.

Many and various examples exist in the plant of confining dust and smoke



Hoods everywhere are the key to the clear atmosphere in this foundry. Large castings are here emerging from a cooling tunnel to be shaken out. Horizontal air cylinder at left pushes drag through opening just large enough to admit it to hooded shake-out

On a well-aired balcony walled off from the main foundry room, this hooded shake-out removes barrel cores from motor blocks. In summer the outer walls of the balcony are opened to provide ventilation; in winter there are overhead louvers to do the trick

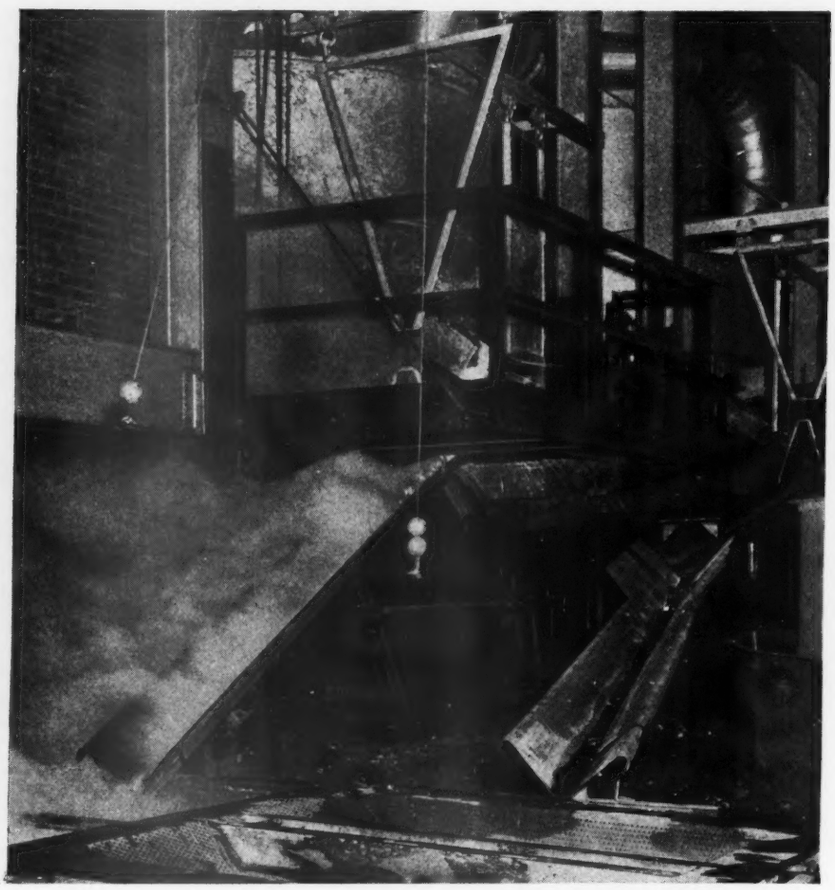
to vented chambers. Small molding, for instance, takes place in an automatic unit which is covered with a housing and exhausted through ducts by blower suction. Molds that have been poured are carried on chain conveyors through cooling tunnels which are similarly exhausted to remove fumes. Shake-outs are hooded, with openings only large enough to admit the units.

Hoods Get Dust at Source

Wherever dust or fumes necessarily occur outside a vented housing, every effort is made to collect this contamination as close as possible to its source. Throughout the plant there are considerable numbers of overhead hoods in evidence, at practically every place where repetitive dust or smoke is occurring. These hoods are all exhausted by blowers in the duct lines; in several sections an entire row of operations has individual hoods over working stations, with ducts all leading up to the main exhaust line. An excellent example of effective hooding is seen in the existence of spray paint booths within 100 feet of welding and snagging operations and hot castings; laboratory tests of room air have disclosed that solvent content anywhere outside the hoods is so small that it offers no fire hazard. All chipping or grinding stations are hooded and exhausted.

Because in a foundry a considerable volume of hot-metal and hot-mold fumes will inevitably escape into the atmosphere despite all precautions to confine them, Harvester's practice is to provide every opportunity for air change. At the highest point of the roof in all foundry departments is a monitor with louvers permitting the escape of impure air. Nowhere, however, is dust allowed to escape into outdoors in any concentration. Dust is handled by wet-type dynamic precipitators which throw the dust into water where it becomes sludge, and which then continuously remove this sludge with automatic scrapers. This type of equipment exhausts a tremendous volume of air from the room in the process of handling the dust. With the many other hoods, ovens, cooling tunnels, and the like which are pulling out air through their ducts, there is a continuous loss of air. The closest estimate available is that the foundry building exhaust system exhausts 238,000 cubic feet of air per minute.

Rather than rely on leakage and natural apertures to replace this air loss, the air is drawn mechanically from outdoors to replace it. Four im-



Slag from cupolas falls into troughs of running water which quenches it and washes it into buckets set in the ground. From there it is lifted out by a hoist and dumped

peller-type blowers are set high up in the peak of the monitor roof, inside louvers. All of these louvers and blowers face to the east, to bring about a uniformity of air direction in the plant rather than set up cross-currents and whirlpools. Between each set of louvers and the fan which serves it, is a large radiation surface of steam pipes to warm the intake air in weather when room heating is required. All told, these four blowers introduce 260,000 cubic feet per minute. The consequence is that internal pressure of the building is maintained high enough so that miscellaneous leakages are not noticeable as drafts. And since all of the exhausts work close to the floor, there is a natural flow downward.

No Fumes From Castings

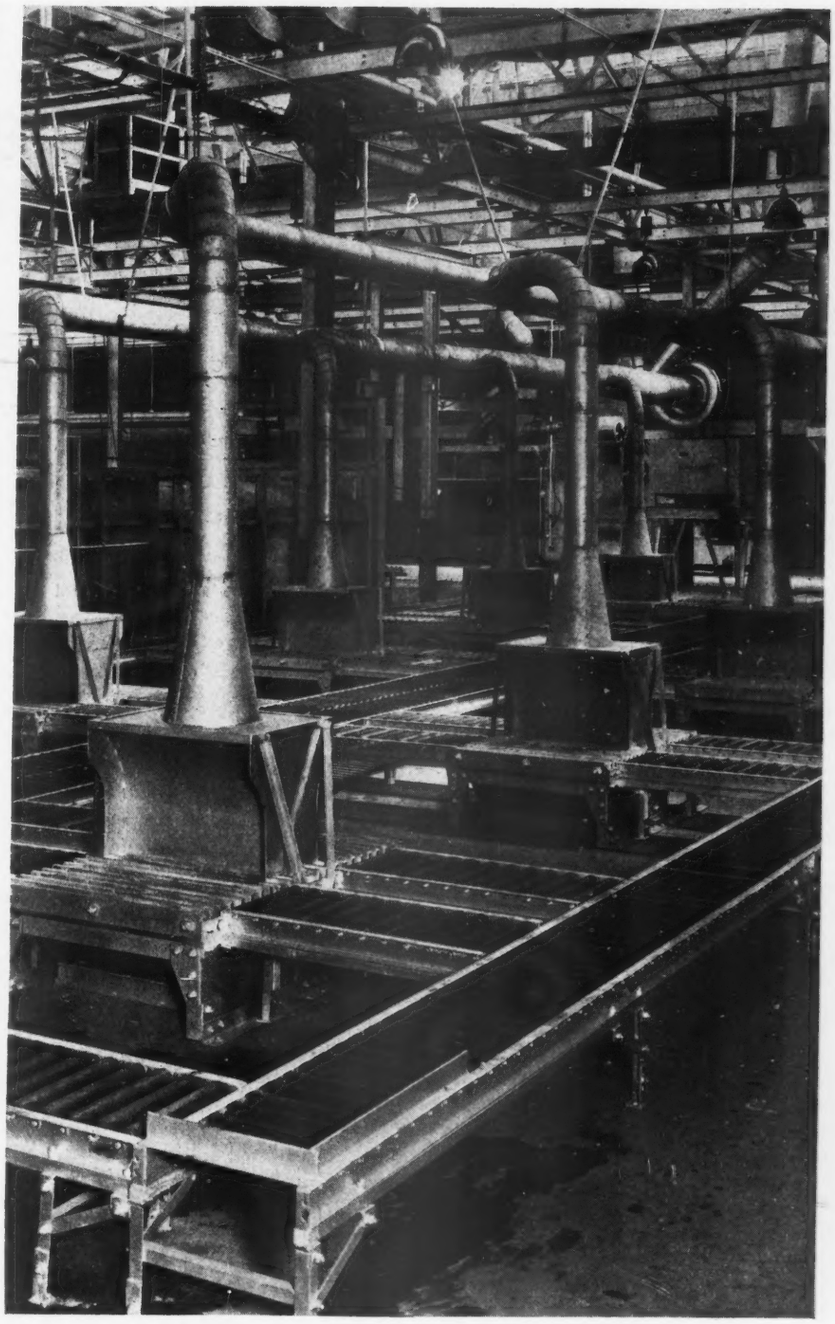
Best example in the foundry of removing sources of contamination from interior spaces is the method employed for cooling castings. As soon as the knock-off operations have been performed on a casting, it goes on an overhead monorail chain conveyor to an upper balcony which is walled off from the main room; in the summer this balcony's outer walls are opened wide, in winter ventilation is close at hand through overhead louvers. On this well-aired balcony the rest of the knock-out and rough clean-up operations are performed. Then the chain carries the still-hot castings out into the sand storage shed. In this structure, which is open on three sides for 30 feet above the ground, the hot castings make six slow lengths up under the roof, cooling for three hours and getting rid of their fumes. When they have cooled out, they return to the point on the working floor from which they came, and proceed along the normal course of their operations.

Slag Quenched in Water

Other examples of the application of the same principle: Cupolas are set along an outside wall so that they are charged from outdoors, under a roof; slag falls into troughs of running water, and the water quenches it, washes it into buckets set in the ground, to be lifted out by a hoist and dumped.

Where all other measures are for one reason or another ineffective, and dust or fumes are emitted at a work station, standard practice is to put a hood as close in front as possible, and a blowing duct behind and above the worker, so that dust or smoke is blown away from his face and into the space where the hood's exhaust can remove the hazard. This method is seen at the point where the large castings are being removed from their drag flasks, where intermediate castings come out of the flasks and move toward the cooling chain, and at several other places. The method of application varies. Sometimes a single blower duct is employed. And at one point where duplicate operations are performed close together, one triangular vent lets the air stream blow toward both workplaces.

The plant has been in operation for so short a time that no figures are available to indicate the health records or other indexes of results attained through this thorough ventilation job. But good ventilation has so repeatedly demonstrated its cash value in improving workers' health and increasing production, that it no longer requires statistical proof. Progressive management, always on the lookout for new methods and equipment that spell dollars and cents savings, concedes that effective ventilation pays its way.



Chipping booths in millroom are exhausted through ducts leading to a dust precipitator

A Dozen Heads Are Better Than One

So maintenance chiefs of Republic Steel's plants get together several times a year, throw their problems on the table, and let the other fellow take a crack at them

C. W. PHILLIPS and I. N. TULL

General Master Mechanic and Superintendent, Electrical Department
Cleveland District, Republic Steel Corporation

No man alone knows all the answers —and if his job has to do with maintenance work, he'll be the very first to acknowledge this to be the truth.

Yet the maintenance man in a single plant has to meet his problem more or less single-handed and learn as he goes along. He has a tough assignment, particularly as there will probably be a dozen new situations to lick for every old one that repeats itself.

Recognition of this fact led Republic Steel Corporation to establish early in its history a committee on maintenance, composed of the mechanical and the electrical superintendents of maintenance from each of its major operating districts, including Youngstown, Warren, Massillon, Canton, and Cleveland in Ohio; Birmingham and Gulfsteel in the South; and Buffalo and Chicago.

Meet 4 to 6 Times a Year

These men, plus members of the operating staff and a representative from the purchasing department, meet as a group from four to six times during the year. In addition, as individuals the members of the committee are frequently called upon for additional trips from their own districts to other districts where their specialized knowledge on some particular maintenance problem may assist in solving a situation which is new to the men in that district, but old stuff to them.

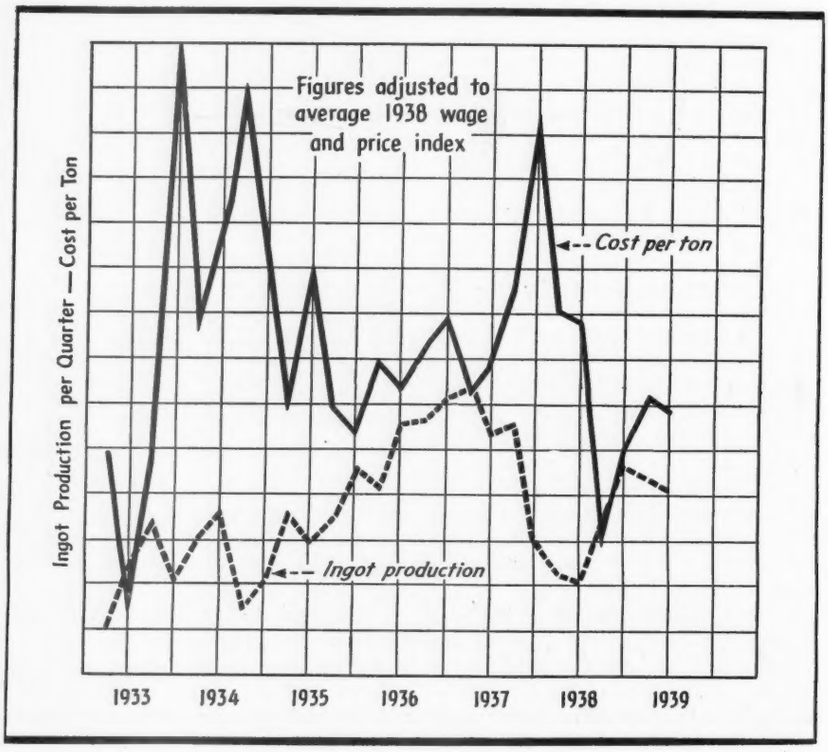
The advantages of this type of committee approach to the development of sound maintenance practices have grown over the nine years since the plan was first inaugurated. The regularly scheduled meetings throughout the year (held in the plants—not in the company's offices) have provided opportunity for exchange of invaluable experiences on maintenance problems.

Inspection trips through the company's plants in the district where the committee is meeting are a regular part of every program. The opportunity which this arrangement offers the maintenance heads of all districts to become acquainted at first-hand with the progress being made in the other fellow's bailiwick is regarded by all of them as invaluable. Considerable time and effort are devoted, too, to the planning of programs for the meetings.

Two days or more may be given to discussions on such typical subjects as (1) maintenance and repair of locomotives and locomotive cranes; (2) problems presented by high-pressure descaling equipment, such as pumps, sprays, etc.; (3) the best methods of lubricating plant equipment; or (4) the most effective way of controlling inventory of supplies and spare parts.

Earlier meetings of the general maintenance committee undertook to discuss both mechanical and electrical subjects in the same session. Within the past two years, however, it has been found advantageous to divide mechanical and electrical men into separate groups.

Similarly, the cost figures for me-



Repair and maintenance costs are charted in terms of cost per ton and ingot production per quarter, to give a quick picture of progress made in this division of operations

Ike Tull first saw the stars over Alabama, but grew up and was educated in North Carolina. Boasts a degree in electrical engineering from State College, at Raleigh. Shortly after leaving college he took General Electric's test course at Schenectady and went to their Cleveland engineering department. Three years later, in 1915, he went with Corrigan, McKinney & Company as electrical engineer. Twelve years were spent in engineering and construction work, and in 1927 he took on supervision of electrical maintenance and operation. Merger of Corrigan, McKinney with Republic Steel in 1935 was followed by further expansion of the Cleveland plant, to give much larger blast furnace and open hearth capacity, and Mr. Tull assumed his present position

Chester W. Phillips hails from Pawtucket, R. I., got his schooling in Massachusetts, and has done most of his work in Ohio. After early training and experience with several well-known firms he started with the Trumbull Steel Company (now part of Republic Steel) as machinist in 1917. From 1921 to 1926 he was master mechanic of the Warren strip mills, in charge of three continuous hot strip mills and 45 cold mill stands. Kept busy from then to 1937 as general master mechanic of the Warren district, handling maintenance of blast furnaces, open hearth coke plant, blooming mill, and 34 sheet and tin mills. During installation of Republic's 98-in. strip mill he was transferred from Warren and became general master mechanic for the entire Cleveland district

chanical repairs and for electrical repairs are separated insofar as this is possible. For example, while the cost analysis of repairs on blast furnaces combines mechanical and electrical work as a matter of practical convenience, these figures are separated in the case of the open hearth and bessemer furnaces, the blooming and billet mills, plate mills, bar mills, hot strip and cold reducing strip mills, and sheet and tin hot mills.

Mechanical and electrical repairs are computed in terms of cents per ton of steel produced. Cost figures are kept for each month and compared with the performance for the preceding month, the year to date, and the average for the preceding year. With actual figures as well as the foregoing comparisons available by districts and by individual operations, it is a simple matter to spot those places where the greatest progress is being made—and those other places where improvement is necessary. The figures are also prepared in graph form, as shown here, to show the definite trends of costs, efficiency, and performance.

Republic has established in its maintenance work a system of bonus incentives based on careful time studies of each type of repair job. In the shops the men are paid a bonus based on the time saved over and above the rate established for the operation. On outside operations such as those involving sheeters, riggers, track labor, and common labor, the work is put on a contract basis with the labor of all crafts figured together for each job. Here, too, where the actual cost of doing the job is under the contract figure, the men share in the savings.

Our maintenance personnel in each district and plant has been divided into two groups. The first group, consisting of machine, boiler, welding, rigger and forge shop forces, handles the major repairs and replacements. The second group consists of men who may properly be said to compose the preventive maintenance crews. They have regular inspection assignments and where feasible have been charged as individuals with complete responsibility for the operation and care of particular pieces of equipment.

The outstanding accomplishment of the committee form of approach to the over-all maintenance work in our plants lies, of course, in the fact that we have in the personnel of the group what amounts virtually to a body of consulting maintenance specialists who are available to help solve any particular problem in any plant.

When it is considered that maintenance costs exceed, sometimes by as much as 100 percent, the ordinary appropriations for new equipment in a progressive mill it can be realized that the time and attention devoted to improving maintenance practices represents a worth-while investment.

Our Oilers Are Proud of Their Jobs

Given definite territories to cover, they are held responsible for smooth functioning of machines in their areas

E. J. KELLY

Plant Engineer, AC Spark Plug Division, General Motors Corporation, Flint, Mich.

CENTRAL CONTROL of machine lubrication has been standard practice with us for the past several years. Up to a few years ago, however, a machine was turned over to the operator and he was told to oil, but no definite procedure was set up either as to time or kind of oil and grease to use. But with multiple shifts and changing foremen, entirely too many motors burned out. It was necessary at that time to keep the motor winders in the maintenance department to repair the damage. Analysis indicated that worn bearings dropped the rotor to contact with the stator, which resulted in burn-outs.

This analysis of the effect of poor lubrication on motor trouble led to an investigation of the reasons for and cost of machine repairs. It was found that a big percentage of the work on bearings and slides was due to poor, or improper, lubrication. This further strengthened the case for central control. Of course it was impossible to fix responsibility under the old plan; one would say the machine or motor was all right on his shift, another, that it had been oiled on his shift. Then production foremen had their pet oils, and a miscellaneous collection of oil fittings existed to use these oils and greases.

The solution to these difficulties was fixed responsibility. The works engineer was given control over every oil hole in the plant. It at once became obvious that an organization for the discharge of this responsibility was necessary, and that experience and experimentation needed to be combined into improved practices. With many hundreds of motors, and many hundreds of machine tools, it was equally obvious that system could become elaborate, but this was avoided.

To begin with, the concept of an oiler as a man with an oil can was dropped —not an easy thing in an organization that had become used to this idea. Seven men are necessary now to oil adequately all machinery and general factory equipment, but these men are not classed as laborers. The oiler for motors is a qualified electrician, consequently he is capable of realizing when equipment is functioning properly. The oilers for machinery and general equipment are qualified millwrights and are also in a position to express qualified opinion as to the condition of the equipment for which they are responsible. You may say this is unduly costly, but there is not the slightest chance of a change to lower rated workers, for we realize how much these skilled oilers have saved the company in maintenance costs.

GENERAL REPAIR TICKET DATE 8-17-39

TOOL OR EQUIPMENT NO. — BRASS TAG NO. 476489 DEPT. NO. 479

OPERATION _____ PART NO. _____

TROUBLE ENCOUNTERED

Oiling Line Shaft

REPAIR MAN NO. 400642 REPORTED BY

O.K. INSP. O.K. FOREMAN J. Doe

CHARGE LABOR DEPT. NO. 741 ACCOUNT NO. 541

Figure 1. Manufacturing department foreman issues this ticket to oiler, millwright, or electrician for time spent in his department. Time is noted on back of duplicate which is issued to maintenance man. Foreman keeps the original in his repair book

Made the Job "Rate"

A further step was necessary. The job of oiler had to be made important in the eyes of the oilers themselves, and in the eyes of their fellow workers, for it was recognized that no job can be well done unless it "rates."

This idea worked in nicely with the physical requirements of the job. With some 20 acres of floor space, a zoning of territory for each oiler was necessary to conserve walking effort and to fix responsibility. At the same time, however, it conveyed a sense of proprietorship to the oilers.

Now each oiler has a responsible job to do, the geographical limits of which are fixed. He has to live with his equipment and soon comes to know its peculiarities and requirements. We do not go in very much for written instructions and procedures for these were tried but abandoned. It was found better to have a new man taken over the territory by his foreman and to have him work with the experienced man for two or three days.

How well this sense of responsibility

results in good performance is illustrated when a new piece of equipment is brought into an oiler's zone. A lubrication instruction sheet from the manufacturer usually accompanies it. The oiler is after this sheet at once, and furthermore, he is after the master mechanic and machine repair foreman for information as to how the machine should be oiled.

Responsibility is fostered in still another way. Whenever a machine is taken to the repair shop the oiler in the zone from which the equipment came is brought in. I say brought in, but that is hardly ever necessary; he is there first to find out for himself whether he is in any way responsible. Cases of failure due to lack of lubrication are now happily rare, but new conditions not heretofore within the range of experience of the oilers do offer training possibilities. The idea here is not necessarily to blame, but to indicate the importance of the oiler's job.

Shift Men Occasionally

Oilers are rotated occasionally among the zones to develop flexibility, and a general utility oiler is trained to fit into any of the zones. Care, however, is exercised not to shift too frequently, for we do not want to weaken the sense of responsibility and feeling of proprietorship these men have for their own territories.

The difficulty of oiling some equipment during operation is avoided by a staggered lunch hour. The oilers take their lunch one-half hour earlier than production workers so that they can oil certain equipment idle at the regular lunch hour.

Each oiler has his own oil and grease cabinet. This is a specially constructed sheet metal cabinet with shelves for grease guns and the different kinds of greases needed. A special compartment is set aside for fittings and for hand tools he may require in his job. These cabinets are on casters, although they ordinarily remain fixed, and are kept locked. A hand fire extinguisher is strapped to the top of each one as a safety precaution. On the door is space for hanging a red metal tag bearing the number of the department in which the oiler may be working.

In these cabinets a three-days' supply of oil and grease is kept. Empty containers are returned to the oil storeroom and full ones secured. The cabinets are compact, and the method in which they are handled keeps the oil and grease clean and goes a long way to reduce fire hazard.

Poor work on an oiler's part is easily checked through the small amount of paper work we require. When an oiler goes into a manufacturing department he asks the foreman for a General Repair Ticket (Figure 1) for oiling; on this ticket the oiler's starting time is noted. When the oiler completes his work, the time he has spent in the department is entered on the back of the duplicate copy of the ticket, and the ticket is signed by the foreman. The duplicate is given to the oiler and the foreman keeps the original in his general repair ticket book. From these duplicates the oiler makes out a time ticket (Figure 2) which is matched with the general repair ticket by the timekeeper.

The original goes through the payroll procedure while the duplicate is filled by departments in the works engineer's office. These tickets are available for examination by the foreman in charge of oilers, and, monthly, they are sent to the superintendents in charge of the various productive foremen who issued them originally. Since the time of oiling is charged against the budget of operating supervision, they should have a chance to question any expenditure of time for oiling, or what they feel may be an incomplete job.

Should a failure occur through lack of lubrication these tickets are available to indicate when and how much time was spent in the department where the trouble originated.

Now for a description of the way in which our skilled maintenance oilers aid in reducing maintenance costs and repairs. Let us suppose that an electrical or millwright oiler finds a piece of apparatus not functioning properly; it may be heating too much. Let us assume also that he cannot fix the trouble with his wrench or pliers, which he would do if it is only a loose connection. He makes out a memorandum slip which bears in bold letters across the top: *Avoid Verbal Orders*, indicat- the piece of equipment, the trouble, and when it should be fixed. This comes to his foreman (electrical or machine repair). If it is not a pressing difficulty it goes on the inspection schedules of these foremen. The maintenance foreman makes his inspection and assigns millwrights or electricians to the job if his judgment corresponds to that of his oiler, as it generally does.

With literally thousands of oil holes in the plant, a rigid schedule would be difficult to work out and we do not do it. Experience indicates that some equipment should be oiled twice daily, others once a week, or perhaps once a month. However, all sleeve-bearing motors are oiled and inspected weekly, and ball-bearing motors are inspected every six months and greased yearly.

Obviously, a lot of experience and investigation has gone into determining the kind of lubricant to use for specific purposes. Although we generally follow recommendations of equipment manufacturers, a lubricant near to that recommended may be used in the interests of standardization. We have blueprinted a specification sheet, a section from which is shown in Figure 3, showing all oils and greases carried in stores and the applications for which they are to be used. Oilers follow these specifications in their work.

Our experience has taught us a few don'ts. Too much oil or grease may be quite as serious as too little. Surplus

PRINTED IN U.S.A. **EMPLOYEES WORK ORDER TIME TICKET**

EMPLOYEE NAME: J Doe		EMPLOYEE NO.: 400642
DESCRIPTION OF WORK: Oiling		ORDER NO.:
		ACC'T NO.: 541
TIME STARTED	TIME FINISHED	TOTAL HOURS: 2
FOREMAN'S OK		RATE
DATE: 8-17	GROUP NO.:	CHARGE DEPT.: 741
		TOTAL CREDIT

Figure 2. Oiler makes out his own time ticket from duplicate general repair ticket issued to him. Time clerk checks it, then sends it to cost and payroll departments

GENERAL LUBRICATING OILS

(Arranged in order of viscosity)

Symbol No.	Name and Description	S.A.E. No.	Applications
43522	A-150 (or A-15, was 600W) transmission oil	160	Die shoe liner pins (with S-63) Drive chains Conveyor chains Open gears Gear boxes Gas-electric truck transmissions
43524	A-80 extra-heavy crankcase oil	50	Use in general oiling *only* where bearing will not hold lighter oils. Otherwise use A-30 or, if necessary, use A-50
43517	A-50 medium-heavy crankcase oil	30	Use in general oiling if bearing will not hold A-30 Hydraulic oil above 1,500 lb. (also see P-16) Garage and test engine crankcases
43523	A-30 (or A-030 winter) medium crankcase oil	20	General oiling, ball bearings, roller bearings, and sleeve bearings (see A-80 and P-16) Motors and generators below 1,800 r.p.m. or temperature above 130 deg. F. (see P-16) Gas-electric truck crankcases (S.A.E. 40 formerly used)
30152	P-26 heavy engine oil (low emulsion)		Air compressors (cylinder and bearings operating hot, with water contamination) Production: Air cleaner screens, Dept. 42
43509	P-16 (Dynamo) light engine oil (no emulsion)		Motors and generators above 1,800 r.p.m. and below 130 deg. F. (see A-30 and S-13) Hydraulic oil where pressure is under 1,500 lb. (see A-50)
43519	S-13 spindle oil		Small motors above 3,600 r.p.m. (see P-16) Close-fitting bearings, High-speed spindles } All grinders

Figure 3. A section from the blueprinted specification sheet that lists all general and special oils and greases carried in general stores, and tells where to use them

grease and oil are annoying to our girl operators, and it settles on floors and walls and increases janitor costs. On one operation we have some motors that reverse each six seconds. Through oversight, a new oiler was not instructed about these special-purpose motors, and he packed the bearings tight with grease. After operating half an hour they heated badly and began to spray oil on the operators. The end caps had to be taken off and the surplus grease removed. Oilers are now instructed to remove the plug from the cap on all ball-bearing motors, force in new grease till the old is expelled, and then run the motor for five minutes until the surplus is flushed out and the pressure eased so the grease will not work out around the shaft later. Generally, our practice is to use small amounts of grease on ball-bearing motors to avoid heat-ups.

Lubricating slides where chips or emery exists is by no means simple. It had been our practice to use grease; however, when the table of one grinder was removed it was found that the slides were scored. It seems the heavy grease retained the emery from the grinding fluid and thus caused the trouble. In this, and similar cases, our practice was changed to using a light oil so that the compound would wash away before it could score equipment.

Soap in lubricants frequently causes difficulty in precision operations. This happened in some roller-bearing motors where the process tool is operated directly from the motor shaft. The soap gummed up, the rollers passed over the gum, thus causing a vibration in the shaft which was transmitted to the product. A soap-free oil is of course indicated for these jobs.

Lubricating equipment upon which a vacuum must be maintained, where shafts project into the vacuum chamber, is a real problem. In one operation of this sort, after testing out several oil seals, we found a water pump fixture and a cork seal sufficient to avoid drawing the lubricant into the process chamber.

Heat Adds Difficulties

Air used in blowing away chips is a frequent cause of trouble, especially in sleeve-bearing motors. That is one reason for more frequent inspection and oiling of this type. A sheet metal cover helps, however, as does a felt shim next to the bearing to keep out dirt and chips.

Heat dissipation may be a factor in many kinds of equipment other than motors. The gears for a new 600-ton press were enclosed in a box containing five gallons of oil of the consistency of 600 w. The oil began to heat up, but instead of changing to a lighter oil we put in a ¾-in. vent pipe which eliminated the trouble. Oiling chains that must run through ovens presents difficulties too. In one such case, where the temperature reached 500 degrees F., we found a heavy soap grease with little graphite satisfactory. A little graphite is a good thing, but if too much is used the oil will evaporate and leave the graphite to build up, seize bearings, and lead to trouble.

The variation from summer to winter temperatures brings changes in lubrication problems, especially in hydraulic equipment. Generally, these difficulties are handled in much the same way as they are by motor car owners; we shift to a lighter or heavier oil as the case may be. Similarly, if we encounter heat due to the brake action of grease, we change to a lighter grease, or to oil.

It must not be assumed of course that the above procedure has completely eliminated the necessity for constructive thinking about our lubrication problems. We are constantly meeting new conditions presented by advances made by machinery manufacturers, by changes in our own processes, and by new and improved grades of oil and greases offered by oil companies.

Maintenance Service Shorts

Readers are invited to contribute brief illustrated articles reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

HEAT AND LIGHT

Deaerating Heater Protects Hot Water System

REGINALD TRAUTSCHOLD, *Caldwell, N. J.*

Substitution of a modern 12,000-lb.-per-hr. open-type deaerating feed water heater for another type of heater at a woolen mill in Tennessee appreciably reduced the cost of steam generation and eliminated troubles and expense caused by corrosion of return water piping.

About 60 percent of the steam generated at 125 pounds gage for process and drying is returned as condensate suitable for boiler use, at a temperature of 140 degrees Fahrenheit. The 40 percent make-up is obtained from zeolite softeners, since the raw water supply has distinct scale-forming characteristics.

For several years there was little indication of pipe corrosion. Then it became apparent that progressive corrosion of the condensate return piping had been taking place. Trouble rapidly became so serious that repairs and replacements were required almost continuously.

An analysis of the raw water supply showed:

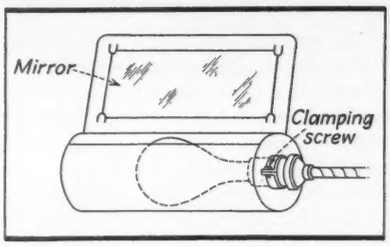
	Parts per Million
Total hardness, calcium as $CaCO_3$	60
Alkalinity, methyl orange	48
Alakalinity, phenolphthalein	0
Causticity	0
Free CO_2	15
Chlorides	6
Sulphates	17
Iron	0.7
Actual hardness, grains per U. S. gallon	3.5

Laboratory tests showed that the deposit in the corroded piping consisted of:

	Percent
Ferric oxide	45.10
Ferrous oxide	0.58
Calcium sulphate	31.10
Magnesium sulphate	15.66
Insoluble matter	0.84
Loss by ignition	4.9

The formation of ferric, rather than ferrous, oxide is indicative of the rapidity of corrosion. While the scale acted to some extent as a protective coating, when it loosened up bare metal was exposed to the corrosive attack of oxygen and carbonic acid. Under the influence of heat in the boiler and closed feed water heater, sodium bicarbonate in the water broke down into sodium carbonate, water, and carbon dioxide. The latter gas passed along with the steam and formed carbonic acid in the condensate.

The open deaerating heater now removes all dissolved gases, including the especially harmful oxygen and carbon dioxide, from the condensate and trap discharges and provides means of automatically admitting the required amount of softened make-up. Steam pressure is maintained at the heater at approximately 1½ pounds gage, so that feed water preheats to steam temperature.



Inspection Light With Mirror Reflector

ROBERT S. ALEXANDER, *Newport, R. I.*

For inspecting those hard-to-get-at places that are so important in effective preventive maintenance, the reflector shown in the illustration is hard to beat. Made from inexpensive light-gage metal, it is used in conjunction with the ordinary extension light. The shade portion is made large enough to admit and give clearance to the light bulb which is screwed into its socket held by the clamping ring soldered to one end.

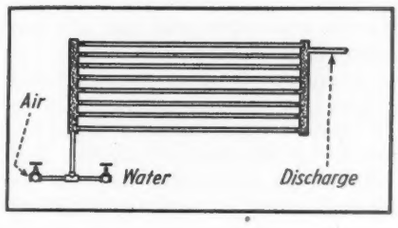
The light directed onto the mirror enables the user to get a clear picture of mechanisms obscured by flanges and other projections which, being difficult to get at by ordinary means, are often neglected with unfortunate results.

BUILDINGS, SERVICES, MAINTENANCE

Shots of Air and Gas Clear Mud From Tubes

P. J. RASMUSSEN, *Corvallis, Ore.*

Watercooled grates used in our dutch oven furnaces are hollow steel tubes made by arc welding two small steel channels along their length. These tubes are welded into sectional headers. The latter are also made from channels welded together, and are of sufficient size to carry enough water to keep the individual tubes filled at all times.



We circulate river water through the grates, and at certain times of the year we have trouble with mud collecting in the tubes and causing serious, localized overheating. We rigged up an extra compressed air connection with valve to give the grates alternate shots of air and water, until nothing but clear water would show at the discharge. The rapid expansion of the air loaded with water would tear loose the mud, where water alone would not remove it.

This idea will work out very well

with pipe lines where muddy water is handled. A word of caution: Do not use this system on weak or old pipe lines that are not designed for the pressure corresponding to the available air pressure, or on lines that have been used for conveying combustible materials or gases.

•

When Signs Mark Dirty Spots, They're Soon Cleaned

R. N. MARSHALL, *Claymont, Del.*

To get our employees into orderly habits and to eliminate those small piles of trash that always seem to accumulate, we made up a few 6x12-in. cardboard signs reading "Dirty—Sign Remains Until Clean, Supt."

Foremen hung these wherever it seemed necessary, and it was hardly any time at all before someone had tidied up each place where a sign was hanging.

We didn't need to use these signs very often after the first few times because neatness soon became a habit.

•

Extension Frame Keeps Jack on Ground for Overhead Work

CHARLES C. LYNDE, *Kilgore, Tex.*

When strengthening old buildings or providing for heavier equipment on upper floors, it is frequently necessary to move or place beams with ordinary house-moving or low-lift hydraulic jacks. If cribbing is used to bring the jack up under its load, much floor space is encumbered, and the cribbing introduces a serious accident hazard.

One plant provides a workable jack extension in the form of an A-frame, with guides through the center brace and head for a piece of 6x6 timber long enough to reach from jack head (when jack is placed on the floor) to point of desired lift.

With the jack placed at floor level,

manipulation of the hand lever is easy, and the thrust is readily transmitted upward through the guided timber to the lift point. To prevent the timber dropping out of its guides when the jack is removed, a ¾-in. hole is drilled through it just above the crosspiece of the A-frame, and a loosely fitting pin is placed in the hole to prevent downward movement.

By providing a number of timbers of various lengths, a jack with comparatively slight lift may be used over a wide range of jobs. A broad timber at the base of the A-frame serves to prevent spreading of the legs, and also affords a footing for the jack.

•

Because they are inherently hazardous, ladders warrant frequent inspection for loose steps or braces; broken or missing bolts or rivets; splintered uprights, steps, and braces.

•

Assign Responsibility for Closing Sprinkler Valves

THERON W. BEAN, *Vallejo, Calif.*

Operation of sprinkler shut-off valves by definitely assigned individuals is a part of fire drill routine that will save money in preventing water damage.

After incurring such damage during a small fire, because employees in the department where the fire occurred had trouble in locating the sprinkler shut-off valve for their section, we posted two framed charts in each section of the plant. One of these charts shows the sprinkler shut-off valves for the entire factory. The other, drawn to a much larger scale, shows those shut-offs for the particular department where the chart is posted.

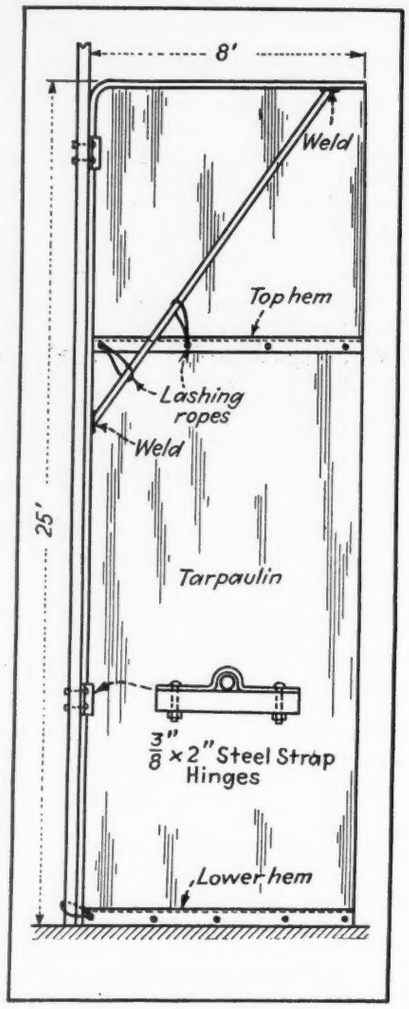
An employee no longer has to hunt for a valve if for any cause the sprinkler system in his department continues to flow after the need for operation is over.

•

Tarpaulin Doors Keep Out Drafts, Let Traffic Pass

J. MURPHY, *Lakewood, Ohio*

The sketch shows one of a pair of inexpensive draft-proof, swinging tarpaulin doors we use between our load-



ing dock and assembly floor. Traffic is heavy through this bay and permanent doors are inadvisable.

Each half door consists of a tarpaulin draped over a length of 1-in. pipe bent L-shaped, with one brace as indicated. It is swung on ⅜ x 2-in. steel strap hinges mounted on vertical beams of the passageway. Although lash strings tie the tarpaulins to the frame in three or

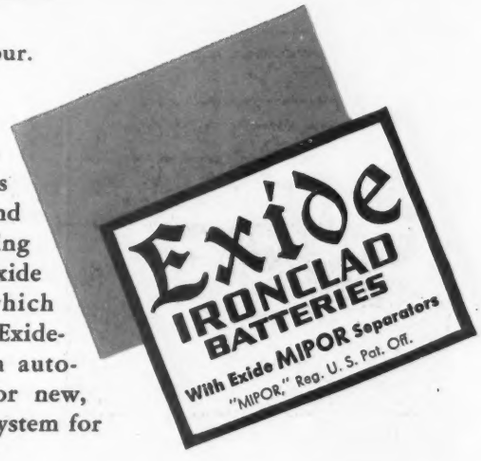
EXIDE-IRONCLADS ASSEMBLED IN STEEL TRAYS ARE THE BATTERIES FOR TODAY'S RUSH

TIME is at a premium today. Minutes count. More materials, and cargo, and freight must be handled in less time—steel mills must be able to handle more heavy coils per turn.

The electric trucks to do this job stand ready—bigger, faster, more powerful trucks that can smooth out handling kinks and speed up production. And the batteries to do the job are ready too—Exide-Ironclads assembled in steel trays, able to bring a smooth flow of mighty power and consistently higher speed to any truck.

These Exide-Ironclads pack more battery power into the same space. They enable you to install a higher voltage, higher capacity battery in the battery compartment of your truck. You get livelier trucks, more power, higher speed, and more materials handled per hour.

Another time-saver is the Exide System which simplifies battery maintenance, cuts down materials handling interruptions, and saves money by prolonging battery life. It includes the Exide Charge Control Unit, which makes the charging of Exide-Ironclads practically an automatic operation. Write for new, free booklet, "The Exide System for Better Material Handling."



THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

The World's Largest Manufacturers of Storage Batteries for Every Purpose

Exide Batteries of Canada, Limited, Toronto

four places, the weight of the tarpaulins is enough to keep them in place.

Located in a bay about 30 feet high and an aisle 12 feet wide, each half door is about 25 feet high and 8 feet wide. There is a lap-over of the tarpaulins, of course, and shipping room and crane and maintenance men walk through here. For trucks and other traffic, the doors are easily swung open.

No binding is necessary along the edges since the weight and stiffness of the tarpaulins keep the edges straight. The lower hem brushes the floor.

•

Yellow lines painted on the floor in front of windows and fire doors help keep them from being blocked and creating a fire hazard.

•

Needed Stack in a Hurry, Used Steel Drums

H. D. WHITESIDE, *Foreman*
Brush Beryllium Company
Lorain, Ohio

Emergency need arose for a temporary stack to carry off fumes produced in one of our processing operations.

Since we could not tolerate the delay that would be occasioned by having a stack made up to fit our needs, use of a makeshift was necessary. Therefore, I suggested that a number of steel drums be welded together at the ends, after the bottoms had been cut out. This was done at comparatively slight cost, and within a few hours we had a stack which served its purpose very satisfactorily.

Bins Keep Motor Parts Together

H. SAUVÉ, *Temiscaming, Que., Canada*

A set of bins of different sizes, in which motor parts and accessories can be stored while motors are being dismantled and overhauled, is a means of preventing loss of these parts. Or, it may save a long hunt when the motor is to be re-assembled.

Sometimes one person will take a motor apart and someone else will put it together again. In such cases it is particularly helpful to have all bolts and other parts together in one bin, and tagged so that it is easy to find the material when needed.

ELECTRICAL UTILIZATION

Identification Code for Distribution Systems

S. H. COLEMAN, *Bethesda, Md.*

Operation and maintenance of industrial electrical distribution systems can be improved by identifying all elements with coded markings indicating the class of equipment, type of circuit, and related service factors. Where this is done trouble-shooting difficulties are minimized, testing is simplified, and accidents to personnel resulting from confusion of circuits are reduced.

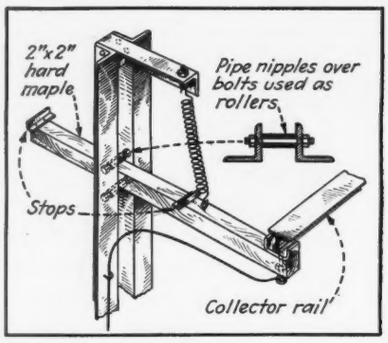
According to the code used in the plants of one large industrial organization all elements are marked as follows:

F	Primary feeder, with various feeders identified by supplementary numerals, as *F*2, *F*16.
S-S	Sub-station, numbered as *S*-S3, *S*-S6.
P	Power circuit, class of service identification.
L	Lighting circuit.
M	Main secondary feeders. Used with identifying numerals, sub-station origin markers, and class of service letters, as *MP2S-S*1 or *ML6S-S*4.
p	Panel or distribution board, used with numerals and class of service letters, as *Pp*1 or *Lp*3.
Arrow	Points in direction of equipment indicated by code markings.
a, b, c	Wires nos. 1, 2, 3 of a given circuit.
Lc	Lighting circuit common wire.
Gnd.	Ground wire.
d.c.	Direct current, when used in conjunction with any of the foregoing.
Mot.	Motor, used with plant serial No. as Mot. 43 or Mot. 198.

These markings are stenciled on all pullboxes and pull fittings, junction boxes, distribution panels, branch motor circuit switches and controllers, and on all conduit runs at points not exceeding 20 feet apart. Lighting circuit branch control panels are supplied with cards at each switch on which is written the location of the light or group of lights which it controls.

Cards of circuits on which lights are to be left burning continuously, such as exit markers, are covered with red cellophane to distinguish them from circuits or lamps that can permissibly be turned on and off when desired. All branch circuits and controls of individual motors are marked with the motor number, starting at the points where the branch leaves the distribution panel. In addition, the door of this panel also bears the numbers of all the motors which it serves.

•



Extra-Flexible Support for Collector Shoe

GILBERT LINDGREN, *Electrical Foreman*
Hudson Valley Fuel Corporation
Troy, N. Y.

Every once in a while we run up against some unusual operating problem that must be solved in a hurry. The result sometimes looks like one of Rube Goldberg's creations, but if it works that is all that is necessary.

The sketch shows a super-flexible collector shoe support that is not very handsome, but it may help some one to meet a problem similar to the one for which we found this support to be the answer.

In service the supporting frame may swing 18 inches or more and still maintain contact between the collector shoe and rail.

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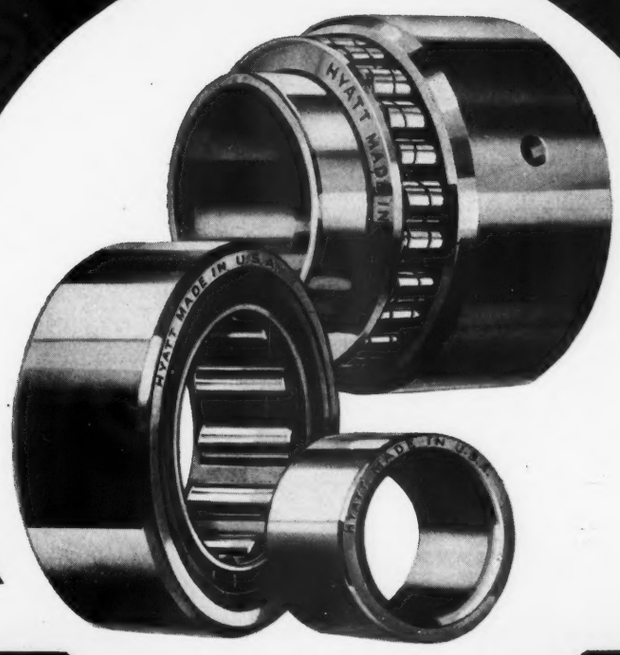
Right Spot

WIDE IN USE... great in performance ... Hyatt Roller Bearings have richly earned their spot in machine design. To carry the strain... to cushion the shocks ... to keep equipment working! Running smoothly, easily, accurately, Hyatts transmit full power... avoid friction... prolong machine life! Use them in the equipment you build—look for them in equipment you buy. Write for Hyatt Engineering Bulletin. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit, San Francisco.



HYATT

ROLLER BEARINGS

QUIET

Effects of Voltage Variation on Motor and Control Operation

C. B. HOUSE

Industrial Department, General Electric Company, Schenectady, N. Y.

OPERATION of standard general-purpose a.c. induction motors and control apparatus at other than rated voltage and frequency tends to affect the normal performance characteristics. This is true also of d.c. motors when the impressed voltage is above or below the rating of the motor.

With purchased a.c. power the standard frequency usually is maintained within close limits. Maintenance of rated voltage is a more difficult matter. Many utility companies supply power from 120/208-volt a.c. network, so that 220-volt motors and controls have to be operated on approximately 208 volts. In any event, all circuits are subject to voltage reduction caused by line drop.

As a rule, general-purpose a.c. motors will operate satisfactorily enough for most applications under a 10 percent increase or decrease in rated voltage.

Also, NEMA standards require that a.c. contactors must be able to stand 110 percent of rated voltage continuously without harm, and close successfully at 85 percent of rated voltage.

A summary of the effects of voltage variations on a.c. motor performance is given in Table I. Reasons why these effects are produced are, briefly, as follows:

Torque and Output. Starting and maximum running torques of induction motors vary approximately as the square of the applied voltage. Therefore, a small change in voltage produces a relatively large change in starting torque and momentary overload capacity. Applications where torque and maximum output are not limiting features may easily withstand a reduction in voltage which would cause trouble in other cases.

Efficiency. With most general-purpose motors the maximum efficiency is

(Continued on page 94)

Table I. General Effect of Voltage and Frequency Variation on Induction Motor Characteristics *

		Start. & Max. Running Torques	Synchronous Speed	Percent Slip	Full-Load Speed	Efficiency		
						Full Load	Three-Fourths Load	Half Load
Voltage Variation	120% Voltage	Increase 44%	No change	Decreases 30%	Increases 1.5%	Small increase	Decreases ½ to 2 points	Decreases 7 to 20 points
	110% voltage	Increase 21%	No change	Decreases 17%	Increases 1%	Increases ½ to 1 point	Practically no change	Decreases 1 to 2 points
	Function of voltage	(Voltage)^2	Constant	$\frac{1}{(\text{Voltage})^2}$	(Syn. speed slip)			
	90% voltage	Decrease 19%	No change	Increases 23%	Decreases 1.5%	Decreases 2 points	Practically no change	Increases 1 to 2 points
Frequency Variation	105% Frequency	Decrease 10%	Increases 5%	Practically no change	Increases 5%	Slight increase	Slight increase	Slight increase
	Function of frequency	$\frac{1}{(\text{Frequency})^2}$	Frequency		(Syn. speed slip)			
	95% Frequency	Increase 11%	Decreases 5%	Practically no change	Decreases 5%	Slight decrease	Slight decrease	Slight decrease

		Power Factor			Full-Load Current	Starting Current	Temperature Rise, Full Load	Maximum Overload Capacity	Magnetic Noise, No Load in Particular
		Full Load	Three-Fourths Load	Half Load					
Voltage Variation	120% Voltage	Decreases 5 to 15 points	Decreases 10 to 30 points	Decreases 15 to 40 points	Decreases 11%	Increases 25%	Decreases 5° to 6°C	Increases 44%	Noticeable increase
	110% Voltage	Decreases 3 points	Decreases 4 points	Decreases 5 to 6 points	Decreases 7%	Increases 10 to 12%	Decreases 3° to 4°C	Increases 21%	Increases slightly
	Function of voltage					Voltage		(Voltage)^2	
	90% Voltage	Increases 1 point	Increases 2 to 3 points	Increases 4 to 5 points	Increases 11%	Decreases 10 to 12%	Increases 6° to 7°C	Decreases 19%	Decreases slightly
Frequency Variation	105% Frequency	Slight increase	Slight increase	Slight increase	Decreases slightly	Decreases 5 to 6%	Decreases slightly	Decreases slightly	Decreases slightly
	Function of frequency					$\frac{1}{\text{Frequency}}$			
	95% Frequency	Slight decrease	Slight decrease	Slight decrease	Increases slightly	Increases 5 to 6 %	Increases slightly	Increases slightly	Increases slightly

* *This table shows general effects, which will vary somewhat for specific ratings.*

"Coming Events Cast Their Shadows"

LET US HELP YOU *SPOT THESE SHADOWS* TO PROTECT YOUR PROFITS AND THE EFFICIENT FLOW OF PRODUCTION

Accidents hurt men . . . delay production . . . interfere with efficiency . . . and raise insurance costs that are shared by each department.

Safety — the type of *practical* safety American Mutual and its policyholders strive to attain — protects men . . . avoids costly interruptions . . . improves efficiency . . . and reduces insurance costs.

American Mutual safety consultants are guided in their efforts to stop accidents by a number of signposts — the record of past accidents, indicating likely sources of future accidents . . . systems, methods and operating techniques that, unsuspectedly, permit accident hazards to exist . . . the attitudes of management and workers, revealing the extent to which they are willing to work together to remove those hazards.

American Mutual consultants know sound *operating* practices as well as *safety* practices... their recommendations fit in smoothly with your plans for greater efficiency and greater profits. The American Mutual staff includes men who are intimately acquainted with the operating techniques of your particular industry.

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BRANCHES IN 59 OF THE COUNTRY'S PRINCIPAL CITIES

Effects of Voltage Variation on Motor and Control Operation

Table II. General Effect of Voltage Variation on D.C. Motor Characteristics *

Voltage Variation	Starting and Maximum Running Torques	Full-Load Speed	Efficiency			Full-Load Current**	Temperature Rise, Full Load	Maximum Overload Capacity	Magnetic Noise
			Full Load	Three-Fourths Load	Half Load				
				Shunt Wound					
120% Voltage	Increased 30%	110%	Slight increase	No change	Slight decrease	Decreases 17%	Main field, increases. Commutator field and armature, decrease	Increased 30%	Slight increase
110% Voltage	Increased 15%	105%	Slight increase	No change	Slight decrease	Decreases 8.5%	Main field, increases. Commutator field and armature, decrease	Increased 15%	Slight increase
90% Voltage	Decreased 16%	95%	Slight decrease	No change	Slight increase	Increases 11.5%	Main field, decreases. Commutator field and armature, increase	Decreased 16%	Slight decrease
				Compound Wound					
120% Voltage	Increased 30%	112%	Slight increase	No change	Slight decrease	Decreases 17%	Main field, increases. Commutator field and armature, decrease	Increased 30%	Increased slightly
110% Voltage	Increased 15%	106%	Slight increase	No change	Slight decrease	Decreases 8.5%	Main field, increases. Commutator field and armature, decrease	Increased 15%	Increased slightly
90% Voltage	Decreased 16%	94%	Slight decrease	No change	Slight increase	Increases 11.5%	Main field, decreases. Commutator field and armature, increase	Decreased 16%	Decreased slightly

* *This table shows general effects, which will vary somewhat for specific ratings.*
** *Starting current is controlled by starting resistor.*

(Continued from page 92)

reached between 75 and 100 percent of full load. With a constant-hosepower load the primary copper losses near full load vary as the square of the current, which in turn varies approximately as the square of the load and inversely as the square of the voltage. Therefore, the primary copper loss varies inversely as the square of the voltage, which is also true of the secondary copper loss. Core loss varies almost as the square of the voltage.

The net result is to lower the efficiency at less than rated voltage.

Frequency. Assuming a constant-horsepower load, small changes in frequency have little effect on the current and therefore on the copper losses. Core loss is increased when frequency is reduced, and *vice versa.*

Friction and windage losses are decreased as frequency drops and *vice versa,* because of the change in speed.

Power Factor. Reduction of voltage from normal at rated load reduces excitation current and increases the in-phase or load current. Hence, it tends to raise the power factor.

Current. Starting or blocked-rotor current is reduced in proportion to, sometimes slightly greater than, any reduction in voltage.

Running current of the average motor will be slightly higher than normal when operation is below rated voltage.

Speed. Slip of an induction motor varies approximately inversely as the square of the voltage, but since slip is normally only a few percent of synchronous speed, a 5 percent reduction, say, in voltage will produce little change in the speed of a 220-volt motor.

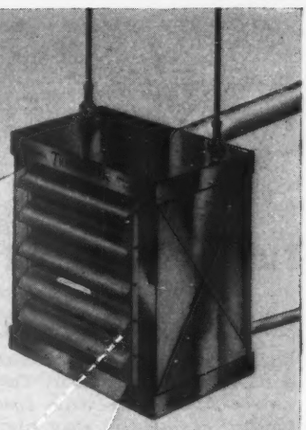
Heating. Temperature rise above the ambient varies with the watts loss to be dissipated and the motor speed. Small changes in line voltage do not change the speed sufficiently to affect materially the rate of dissipation of heat. However, the lowering of efficiency that comes with a drop in voltage tends to increase the temperature rise, but not sufficiently to be of material consequence.

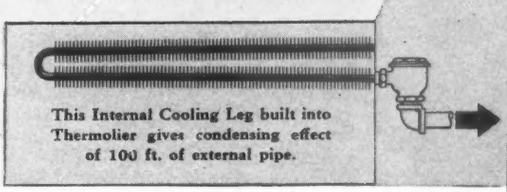
Motor controls will operate satisfactorily on voltage variations 10 percent above or 15 percent below normal. In general, between these limits the higher motor current will not overload contacts, relays, or other elements. Contactor coils will operate at a lower temperature rise on the lower voltage. Overload relays will protect the motor and control, but the amount of overload that can be carried will be reduced somewhat, assuming that the relay rating and setting match the motor nameplate data.

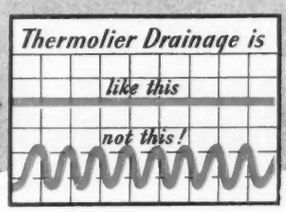
Direct-current systems are also subject to variations in voltage above or below the rated value. Table II shows the effects in general on the performance characteristics of shunt- and compound-wound d.c. motors produced by operating them at voltages above and below normal.

THERMOLIER EFFICIENCY *BEGINS* WITH...

THIS ADDED "FULL HEAT" ZONE!







Cuts cost of installation, operation, maintenance

Here is a unit heater so efficiently designed that it has required no changes since its original development! In 12 years of service, Thermolier has shown exceptional economies due to its superior features.

For example, the exclusive Grinnell Internal Cooling Leg provides *continuous* drainage of condensate . . . prevents intermittent filling of lower sections . . . insures constant, live-steam heat in lower, as well as upper, surfaces. It contributes to Thermolier's high fuel-saving (up to 27%) . . . permits use of low-cost traps . . . and eliminates depreciation caused by intermittent drainage cycles.

Many other Thermolier features also promote overall economy. Special "condenser-type" tube-to-header construction prevents loosening of joints. U-tube heating elements automatically eliminate expansion strains and wear. Simplified pipe-connections and hangers cut installation costs. And pressure-testing of every unit insures tight assemblies for minimum maintenance.

Write for Thermolier Data Book describing 14 superior Thermolier features that cut installation, operating and maintenance costs in heating systems. Grinnell Co., Inc., Executive Offices, Providence, Rhode Island . . . Branch offices in principal cities of the United States and Canada.

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THE UNIT HEATER WITH 14 POINTS OF SUPERIORITY

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YOU SAVE ALL THREE
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Kinnear Rolling Doors save valuable floor and wall space by **coiling** out of the way above the opening.

They save **time,** by opening quickly, smoothly and easily all year long — snow, ice or swollen ground **can't** get in their way. They save **money,** too. Their rugged, durable, all-steel construction and interlocking-slat design mean longer lasting, **carefree** service. When opened, they **stay put** — out of the way, out of reach of damage by wind or vehicles. They will not sag, warp, split or pull apart. They give extra protection against fire, are weatherproof, and present an all steel barrier against thieves, intruders and rioters.

Moreover, every Kinnear Rolling Door is especially built to exactly fit the individual requirements. This reduces installation, operating and maintenance costs.

Kinnear Doors are built for any opening, in new or old buildings, with motor or manual control.

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KINNEAR
ROLLING DOORS

You Want to Know

more about the items mentioned on this page.
Letters to the addresses given will bring information

• STAPLER, not much bigger than a jackknife, has detachable base that permits it to be used as a plier-type fastener. Holds 100 staples, will fasten 50 sheets of 16-lb. bond, can be used as tacker; locks shut to be carried in the pocket. Made of steel and plastics. Bostitch, Inc., East Greenwich, R. I.

• "PLANNING the Industrial Apprentice Training Shop" is title of a booklet giving pointers on organizing shop work and selecting equipment for training machinists. Four sample shop layouts for training 25 to 75 apprentices are shown, and there is a detachable form which, filled out, will bring a floor plan to fit your shop. South Bend Lathe Works, South Bend, Ind.

• LOOKING FOR IDEAS for your employee publication? Twenty-four-page bulletin containing talks and much of the discussion on the subject as presented at first annual convention of the American Association of Industrial Editors, Inc., 1964 East Ninth St., Cleveland, may have just what you want. Price: $1.

• EXECUTIVES transferred to another town can swap their old house for one where they're going through Transferred Executive Guild, a realty organization operating through correspondents in 120 cities. It maintains lists of suitable homes for rent and for sale in these cities. Carley Realty, 1171 Washington St., West Newton, Mass.

• SYNTHETIC LEATHER PASTE applied to metal or wood pulley is said to insure frictional grip for a slack belt, and to be impervious to action of oil, grease, chemical acid-gases, dust, heat, and frost. Powerlox Mfg. Co., 507 Fifth Ave., New York.

• LABOR SITUATION is discussed from the war angle in "Labor Economics in a Period of Change," and from the union angle in "Conciliation and Cooperation in Collective Bargaining." Pamphlets are 25c. and 75c. respectively. American Management Association, 330 West 42d St., New York.

• YOU NEEDN'T BE SHOCKED when you remove bases of broken lamps from receptacles. Lamp-base remover, for medium and mogul screw base, provides the safe way. The Ericson Mfg. Co., 5716 Euclid Ave., Cleveland.

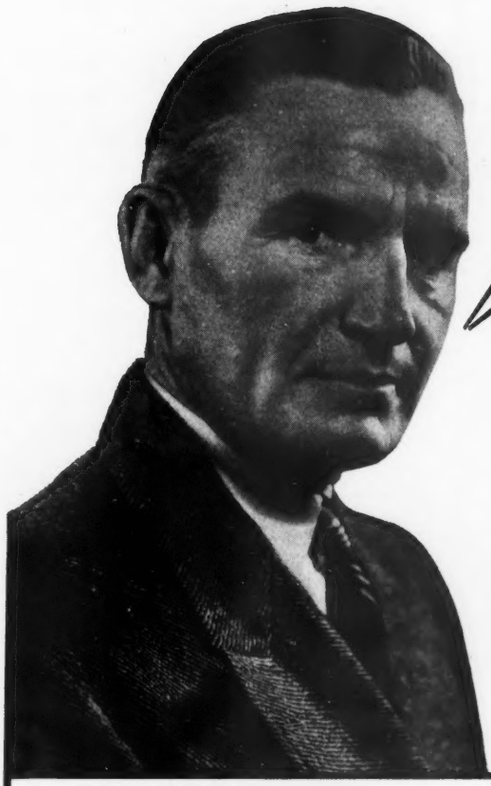
• ENGINEERING DRAWINGS are reproduced in any size in a matter of minutes, instead of requiring days of redrafting, by a photographic process. Huge camera snaps pictures and, after negatives have been developed, projects images, blown up or reduced, on metal, wood, cloth, paper or other surfaces sensitized with a special emulsion. By reproducing image in correct scale on material from which parts are to be made, it is possible to cut parts directly. The Glenn L. Martin Co., Baltimore.

• "SCIENTIFIC Price Management I" makes use of calculator charts to show at a glance the changes in production volume required to offset either increases in cost from any source, or discounts from prices. The text includes 15 actual case studies of pricing problems ranging from simple price cuts to problems involving advertising, production rates, sales. $5. The Eddy-Rucker-Nickels Co., Harvard Square, Cambridge, Mass.

LOOKING LIKE a two-tone checkerboard in red, black, or green, this protective floor covering of ribbed rubber is 5/16 in. thick, comes in rolls 54 in. wide and 30 ft. long. Said to be non-skid and non-creeping, with ribbing deep enough to catch dirt, wide enough for easy cleaning. The Goodyear Tire & Rubber Co., Akron

• PAINTBRUSH PRESERVER consists of metal box having six compartments. Five contain preserving fluid in which hang different-size brushes. A wringer in the sixth extracts paint after using, preserving fluid before using. Yenne & North Mfg. Co., P.O. Box 362, Wooster, Ohio.

• ONE OF THE MOST lucid reports to employees that has come across the editorial desk is one prepared by Plomb Tool Co., Santa Fe Ave., Los Angeles, under the title "What Is Done With the Dollar That a Mechanic Pays for a Plomb Tool in 1940." Not only does it explain how that sales dollar is proportioned among 15 main divisions of cost, but it also goes on to show what part of each



"NEVER BELIEVED SUCH COMBUSTION RESULTS WERE POSSIBLE"

Says **MAJOR OIL REFINERY, ABOUT THE FANMIX GAS BURNER**

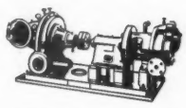
Another COPPUS BLUE RIBBON *Product*

The steam engineer of one of the country's largest petroleum refineries, having operated FANMIX burners over a six month period writes: "Since the installation of FANMIX Burners the average load on the still has been increased 25%. The flue gas temperature dropped from 620° to 530° F. and the CO_2 increased from 9.4% to 11.4%.

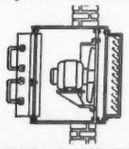
COPPUS BLUE RIBBON PRODUCTS

Designed for your Industry
Engineered for You

COPPUS TANK AND TANK CAR VENTILATORS. For quick ventilation of Tank Cars, Tanks, etc. Supplies fresh cooling air to men working in confined spaces. Bulletin 163-1



COPPUS STEAM TURBINES. For small H.P. jobs—six sizes (and prices) from 150 H.P. down to fractional. Steam — Gas—or Compressed Air driven. Bulletin 135-9.



COPPUS VENTILATOR FILTERS. A combination Ventilator and Air Filter for industrial applications. Bulletin F-370-1.

HEAT KILLERS. Keep production up by keeping men cool. Also for cooling of motors, generators, etc Bulletin 160-4.

NEW OPERATING METHOD

Ensures Perfect Gas . . . Air Ratio

Gas escaping through orifices in the revolving arms, drives the fan and draws in the correct proportion of air. The result is instantaneous, complete combustion. Not only does this give you higher ratings, but you also get eleven other unique benefits from Coppus-Dennis Fanmix Burners.

WRITE FOR FREE FANMIX BULLETIN 410-2

Like all other Coppus products, the Fanmix Gas Burner has a Blue Ribbon. This is your assurance of precision workmanship and careful inspection. Note other Blue Ribbon products described at left.

Coppus Engineering Corporation, 375 Park Avenue, Worcester, Massachusetts. Sales offices in THOMAS' REGISTER: other "Blue Ribbon" products in SWEETS' CATALOG.

COPPUS

MY, JOHNNY, HOW YOU'VE GROWN!

A few years ago Abrasive Products, Inc., was just a lusty infant, too! Because growth brings with it certain advantages to our customers, we're glad to report that this company has entered its big, strapping, healthy "teen-age". Here's what it means to you:

RIGHT ABRASIVE, RIGHT QUICK! . . . AP'S big plant at South Braintree provides ample manufacturing facilities for the wide AP line. No matter what your requirements, the heavy and varied production of this plant provides an abrasive to meet them. But we've kept our spirit young, and we'll still break our production schedule so you won't have to break yours, to give you that special order you need day after tomorrow.

AP ABRASIVES CUT because this plant houses nothing but the most modern equipment to make them *right.* An alert research laboratory is constantly developing new grits, new binders, new backings, and ways of manufacturing the old ones better. Examples: AP New Process Paper for tough jobs; AP Special Garnet, which often replaces more expensive grits; AP Silver-Streak, the disc that cuts fast and cool; AP Velvet-Joint Belts, that stay joined as long as they last.

PRODUCTION AND SALES agree! Yes, it's news, but these two important functions of our business always agree on customer-service. That's why you get 24-hour action on stock orders, 48-hour action on specials. That's why AP has led with developments like "Masterpak" — the sandpaper package that keeps out moisture, prevents damage.

Thus AP gains the advantage of size, of scope, of maturity without losing the personal interest in your needs that every company serving you should have. Make us prove it on your next abrasive order. Abrasive Products, Inc., 519 Pearl St., South Braintree, Mass.

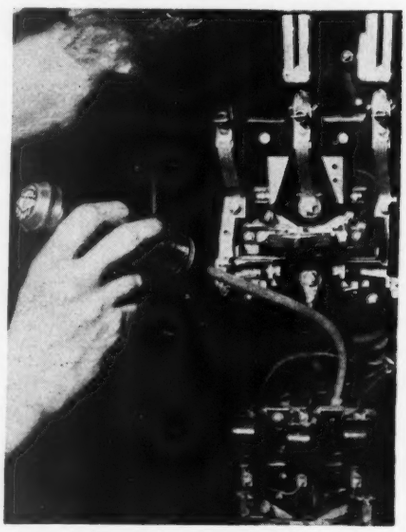
ABRASIVE PRODUCTS INC.
SOUTH BRAINTREE MASSACHUSETTS
JEWELOX • JEWEL EMERY • JEWEL GARNET
JEWELITE • JEWEL FLINT • NEW PROCESS

item of cost finds its way to wages—wages to railroad employees for freight cost, for example.

• ADSORPTION PROCESS for silica removal from boiler water utilizes a single specially prepared chemical in hot process softeners. It is claimed to be low in cost due to high efficiency of the process. W. H. & L. D. Betz, Philadelphia.

• NON-SLIP SHOE takes danger and discomfort out of ladder work. It consists of a steel plate which is held firmly against the sole of wearer's shoe with leather straps, a slip-proof bottom of rubber matting, and grooved arch which grips the ladder rungs. Landon P. Smith, Inc., Irvington, N. J.

•HAMMERED METAL EFFECTS are produced with a new finish which can be applied to products made of metal or plastics. The effect is obtained by first applying a base coat of color desired, and following it with a spatter coat of Hammertone liquid. Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J.



FLASHLIGHT-BULB EXTENSION of copper wire and aluminum alloy tubing bends so that it can be inserted in small openings to light up innards of machinery and other hard-to-inspect areas. Screwed into flashlight socket, it increases the reach of the flashlight up to 36 inches. Sierra Aircraft Co., Sierra Madre, Calif.

• COMPOUNDS of natural and synthetic rubber with a high degree of electrical conductivity, furnished in solution, find application as belt dressing to carry static away from transmission belts. The B. F. Goodrich Co., Akron.

• PAYROLLS can be prepared in a single operation with a mechanical device which posts checks, earnings records, and payroll sheets at the same time. The three specially designed forms are held in accurate alignment while the complete record is made, including computations of earnings and social security deductions. The Todd Co., Rochester, N. Y.

this Winter

with Sturtevant's new MULTIVANE HEATER

THROUGH the adoption of Unit Heating, progressive manufacturers have not only heated their plants more efficiently—but also, *more economically!*

Now, with a further improvement in design, this new Sturtevant Multivane Heater offers you still further savings in fuel and power.

Here is how it works. Specially designed fans handle larger volumes of heated air. Slow speed rotation with belt drive permits the use of standard *stock* motors—and results in quiet operation.

Even more important—because it creates efficient circulation and thus keeps the entire area evenly and adequately heated—wasteful overheating of local areas is avoided. Better diffusion of heat results in lower fuel bills.

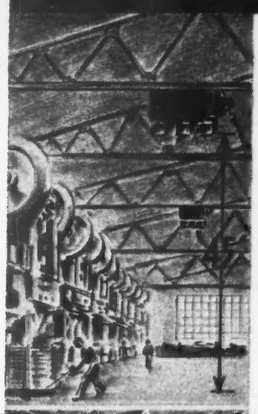
In use, "Multivane" Heaters are exceedingly flexible because they can be installed on the floor, fastened against the wall or hung suspended from the ceiling.

Don't forget, it's good business to eliminate cold-spots and draft-swept areas that keep workers shivering. That is why we say, don't wait until the first cold snap to investigate Sturtevant Multivane Heaters.

B. F. STURTEVANT COMPANY • HYDE PARK • BOSTON, MASS.
Branch Offices in 40 other cities . . . B. F. Sturtevant Company of Canada, Ltd., Galt, Toronto, Montreal

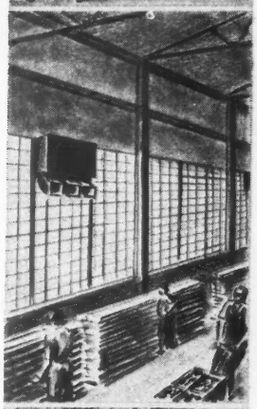
Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

SPECIALLY DESIGNED FOR BUILDINGS LIKE THESE—



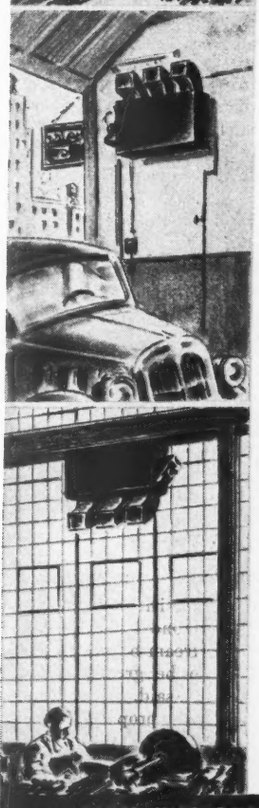
High Ceilings

A mammoth automobile plant found it highly efficient to install Sturtevant heaters upside down on ceiling trusses, with the outlets 45 feet above the floor line!



Large Floor Areas

Stock and shipping room of a large Eastern manufacturer is 460 feet long and 60 feet wide—yet 8 Sturtevant Units handle the entire heating job!



Frequently Opened Doors

A nation-wide chain of Super-Service Stations licked this problem by spotting Sturtevant heaters at open doors to kill cold . . . before it could sweep by!

Large Window Areas

A large industrial plant with windows 18 feet high found this no problem for Sturtevant Heaters—with their large heating capacities and special distribution nozzles!

ACT NOW JUST 1 MONTH UNTIL THE HEAT GOES ON!

This is the right time to do something about a heating system that will cut last winter's fuel bills. You can put in Sturtevant Multivane Heaters now—without interrupting production—and they'll be ready to provide instant warmth on the first cold day.

If you are a plant engineer, architect, consulting engineer, contractor or industrial executive—you will want to investigate this important advance in heater design. Our 24 page Multivane Heater Catalog gives complete information.

MAIL THE COUPON—TODAY!

F.9-40

B. F. STURTEVANT COMPANY
Hyde Park, Boston, Mass.

I am interested in your new Multivane Heater for the following applications:—

☐ Send me a copy of your new 24 page catalog describing this improved Heater.

☐ Have your local Sales Engineer call.

Name.....*Title*.....

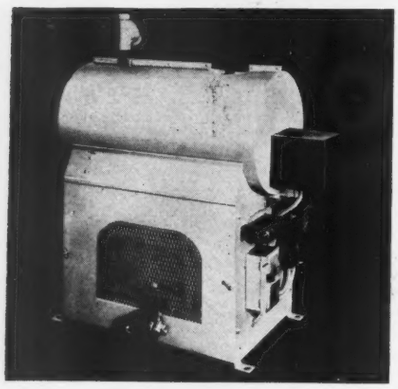
Company.....

Address.....

What's New in Equipment

Heating and Circulating Unit

Heating and circulating system, developed for heat-transfer media where desired temperature is kept below the boiling point of the material used, may be



applied to hydraulic presses, molds, and other machines where circulation of thermostatically regulated heat-transfer media is indicated. Standard unit consists of a tank-type reservoir (10-11 gal. capacity) heated by a thermostatically controlled 6,000-watt electric immersion heater with a motor-driven hot-oil pump, strainer, and automatic pressure relief valve. (Immersion-heater elements up to 11,000 watts capacity are available.) Tank is insulated with glass wool, covered with a steel jacket, mounted on a welded steel frame. Enclosed base frame houses motor and pump and is provided with removable side panels. Interior piping is insulated. Four-in. tank hole facilitates cleaning. John Royle & Sons, Inc., 10 Essex St., Paterson, N. J.

Dust Collector

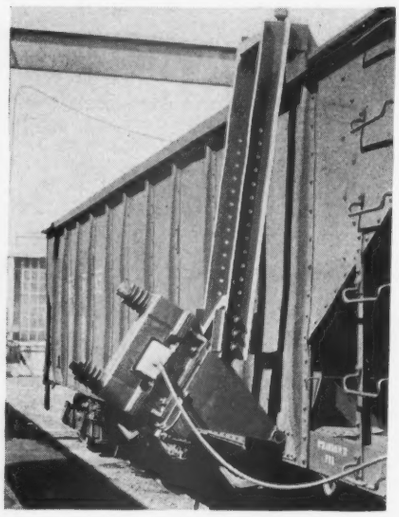
Cyclene dust collector is of the long-cone cyclone type as distinguished from the large-diameter short cyclone type. Dust is separated from the airstream by centrifugal force. Air volume can be greatly varied from rated capacity, it is said. Dust is not stored in the collector proper but in separate hoppers or storage tanks. Collectors are constructed of heavy-gage metal to withstand scouring action of dust collected. Unit can be built in various sizes. The American Foundry Equipment Co., 580 South Byrkit St., Mishawaka, Ind.

Silver-Bowl Luminaire

S-5640 is a luminous indirect lighting unit for use with the 500-watt inside-frosted silver-bowl lamp; S-5630, for use with the 300-watt lamp. Prismatic action of outer skirt of the luminaire is said to bend the light out at wide angles over the ceiling without creating spots, streaks, shadows, or cutoffs. Refracting prisms running about the inner periphery have risers varying from ¼ to ¾ in., and slightly stepped small radial 90-deg. prisms run about the bottom outer portion. Diameter of bowl—17½ in., depth—4⅝ inches. Holophane Co., Inc., 342 Madison Ave., New York.

Relay

W-6 relay for panel mounting is recommended for control of motors, valves, electric heaters, fire and burglar alarm systems. The hermetically sealed mercury contact switch is said to be immune to pitting, oxidation, corrosion; is dustproof and dirtproof. As only a low current is required to energize the operating solenoid, the relay may be employed for remote control in connection with pressure, temperature, humidity, speed, or time controls having delicate contacts. Available for any voltage or cycle between 6 and 230 volts a.c. or d.c. The Mercoid Corp., 4203 Belmont Ave., Chicago.

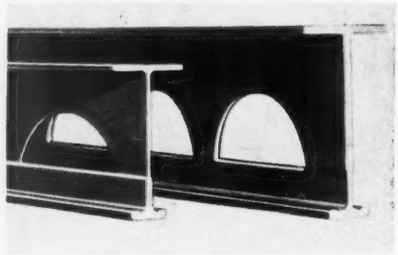


Electric Vibrators

Vibrators fitted with hooks for attaching to hopper-bottomed railroad cars or to big bunkers and storage bins (without the hook) are designed to facilitate the emptying process. Large pulsating electro-magnets, they strike 3,600 times per minute and together with the hook weigh 950 lb. each. On railroad cars they are used two to a car on opposite end-sides. They must be lifted into place by an overhead crane or hoist. Each vibrator comes with a separate electrical control panel (dual controller operating two vibrators) that contains operating switches, a thermionic valve for changing a.c. to pulsating current, and a variable resistance for controlling the vibrator's amplitude or power. Operates on 220-volt single-phase a.c. Syntron Co., 480 North Lexington Ave., Homer City, Pa.

Arch Beams

For overhead materials handling systems for loads up to 5 tons. Three sizes: No. 3000—depth of 12 in., weight of 28 lb. per



ft.; No. 3100—depth of 12 in., weight of 33 lb. per ft.; No. 3200—depth of 15 in., weight of 50 lb. per foot. Each beam consists of a wide flanged T-member to which is welded a high-carbon rail having a hard flat raised tread or running surface. Its vertical member is arched at regular intervals to reduce weight. Rails for 5-ton systems have an over-all width of 3¼ in., a lower flange thickness of ⅝ in., wearing strips ⅝ in. wide by ⅛ in. thick. Ball and socket swivel connection both at the ceiling or superstructure and at top of beam flange support the arch beam. Free-swing suspension relieves tension stresses in supporting rods and fittings. The beams can be used with either hand-operated or electrified Tramrail Systems. Cleveland Tramrail Division, The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Welder

WD-150 welder, range from 200 down to 15 amp., features single control for current selection. Available in portable or stationary mountings, the welder features square frame design to provide better arrangement and greater cooling area of coils, and to permit stacking of two or more units for parallel hookup. With this paralleling device single current control is carried over to the combined machines. The selector of each is connected to the others through a "multiple shifter" which when set for a given current automatically sets the connected machines at that amperage; e.g., when 375 amp. are desired from three machines the shifter is set at 125 amperes. Loosening the wing nut of the connecting rod disengages the rod and permits individual current setting on each machine. Harnischfeger Corp., Milwaukee.

Handsaw on Radial Arm

Speedmatic electric handsaw, base removed, can be mounted with its motor on a radial arm and thus provide the com-

TRIPLE PROOF

ON HOW TO SAVE PRODUCTION DOLLARS WITH ALLIS-CHALMERS LO-MAINTENANCE MOTORS!

Read These True Stories for the Inside Facts on Why Allis-Chalmers Lo-Maintenance Motors are First Choice with Men Who Want Record-Breaking Motor Performance!

WHEN THE GOING gets tough and profits depend on performance — that's when you need Lo-Maintenance Motors more than ever!

For, don't forget — Allis-Chalmers Lo-Maintenance Motors are built to operate under the most severe conditions.

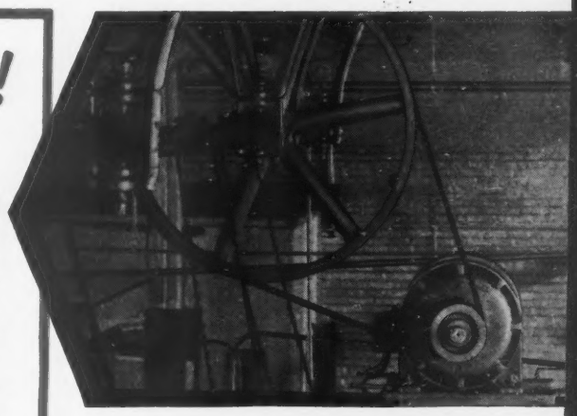
High carbon steel frame... indestructible rotor . . . Distortionless stator . . . no skimp or stint in materials and workmanship— all these are real reasons why Lo-Maintenance Motors hold an industry-wide reputation for standing up under conditions that many times wreck ordinary motors.

Get the complete Lo-Maintenance story. Call the engineer in the district office near you . . . or write Allis-Chalmers, Milwaukee.

A 1280

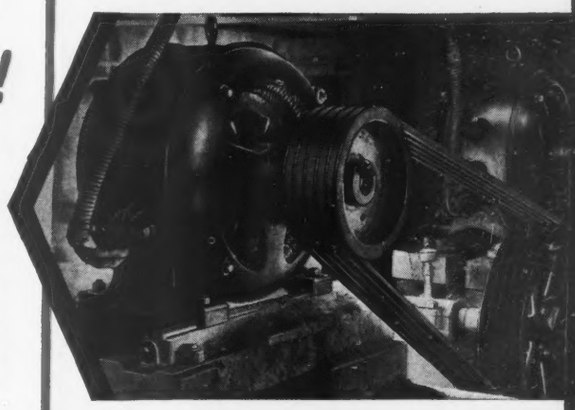
NINE YEARS IN A DYE HOUSE!

ORDINARY MOTORS WERE cracking up in 12 to 14 months in the dye house of the Wilkes Hosiery Mills Co. Then they installed an Allis-Chalmers Lo-Maintenance Motor that made news! After nine years of service . . . that Lo-Maintenance Motor was running as perfectly as the day it was installed!



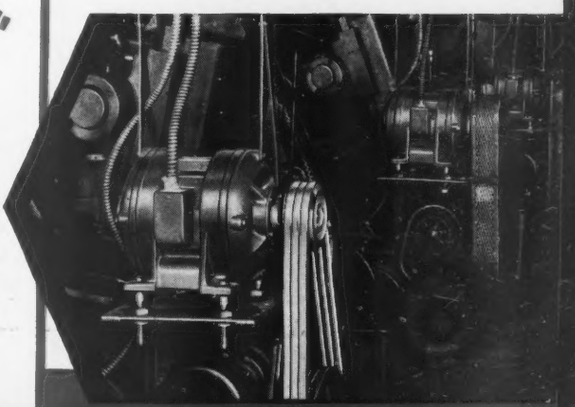
29 YEARS ON THE ROCKPILE!

TURNING ROCK CRUSHERS . . . with highly abrasive lime dust filling the air — these two 50 hp Lo-Maintenance Motors have been going 29 years without running up high repair or maintenance expenses for the Waukesha Lime & Stone Co.



"WE'LL TAKE A CARLOAD!"

WHEN THE WARNER AUTOmotive Parts Division of Borg-Warner needed motors for a new plant, they checked motor operation in their other plants . . . found Lo-Maintenance led in performance and low cost. That's why they ordered a carload — 346 at one time!



Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

bined advantages of the portable electric handsaw and a radial-arm-type cross-cut and rip saw. The arm moves back clear of the table, provides for a 26-in. stroke, may be raised 7¼ in. by a handwheel, may be swung right or left, is locked by a lever, runs on ball bearings; rip guide may be placed to rear so that stock 65 in. wide may be halved; regular adaptor permits tilting unit 45 deg., a special adaptor 90 deg.; hold-down and kick-back prevention device is built into adaptor; radial arm with wood work table is mounted on a steel frame and stand. Capacity is up to 4½ in. deep. Cuts compound angles. Saw may be set at any bevel. Porter-Cable Machine Co., 1714 North Salina St., Syracuse.

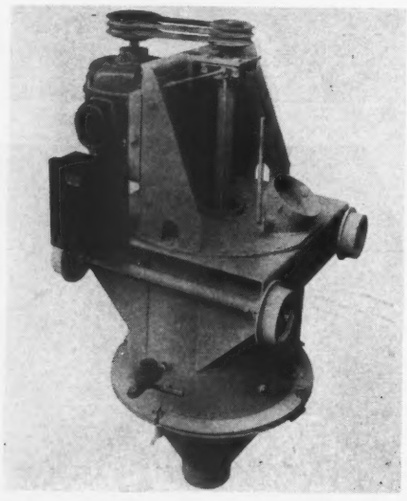
Speakers

Bi-Directional Speaker for factory call and paging systems is equipped with molded non-metallic baffles and a swivel-joint mounting bracket. Unit measures 9½ by 5 in.; nine to twenty speakers can be connected across the 250 or 500-ohm line; transformer is tapped for 2,500, 3,750, 4,000 or 4,750 ohms.

Wall Reproducer for sound systems requiring reproducer for music and voice will find use in concerns employing sound systems for employee entertainment as well as for communication. Molded housing is non-metallic. Utah Radio Products Co., 820 North Orleans, Chicago.

Wet Disposal Unit for Dry-Type Dust Collectors

Designed for wetting and mixing with water or other liquids the collected dust discharged from hoppers of cloth-filter type or other dry-type dust collectors. The wet disposal unit is a self-contained mixer which receives dry dust from the collector hopper and deposits it near the center of a high-speed mixing disk. Water or other liquid is discharged at the center of the disk, dust and water are mixed and flow from the sludge discharge at the bottom.



Amounts of dust and water mixed together are under control of the operator. Disposal unit is powered with a 1½-hp. motor, disk inlet and sludge outlet are each 6 in. in diameter. The American Foundry Equipment Co., 581 South Byrkit St., Mishawaka, Ind.

Speed-Variator Equipment

A complete speed-variator equipment is now available as a standard unit operating from 3-phase, 60-cycle, 220, 440, and 550-volt a.c. to provide wide ranges of adjustable speed by means of generator-voltage-control. Consists of an adjustable-speed d.c. motor, an adjustable-voltage motor-generator set with control, a separately mounted potentiometer-type generator-field rheostat which provides speed changes in small increments over wide ranges. Speed ranges available up to 16 to 1 ratio. Motor can be mounted directly on the driven machine with speed-changing control mounted near by. The unit is suitable for applications where adjustable speed has a direct bearing on control of quality and output of the driven machine, to material handling and processing applications. General Electric Co., Schenectady, N. Y.

Pneumatic Tire

Jumbo Jr. tire, tube, and wheel combination is now available for two-wheel hand trucks. The tires are 8-24 in. over-all diameter; 2, 4, 6, and 8-ply; load capacity range from 180-1,500 lb. per tire. The General Tire & Rubber Co., Akron.

Skin Protection Cream

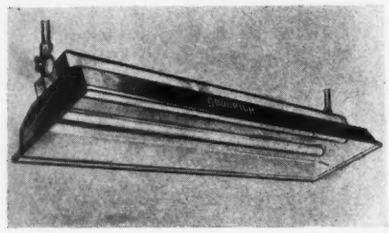
Ply No. 8 vanishing cream furnishes protection to welders and cutters when rubbed into the skin such that in operations requiring use of large-diameter rods when flashes occur the skin is able to resist burning from ultra-violet and infra-red rays. Also protects against burn from sun rays. Milburn Co., 905 Henry St., Detroit.

Electrical Connectors

Types XTBS and XDBS are designed to permit expansion or contraction of a tap conductor at any angle to the overhead bus or transformer stud. They are said to preserve the advantage of rigid construction, to warp with the sub-station but not to flop about loosely, to provide a completely universal joint with ball-and-socket alignment guides incorporated in both stud connector and flexible T-connector. Designed to accommodate all sizes of tubular conductors. Burndy Engineering Co., Inc., 459 East 133d St., New York.

Fluorescent Fixtures

Fixture for two 48-in. 40-watt fluorescent lamps has a deep-skirted reflector with closed ends and is finished in porcelain



enamel. Adjustable brackets at both ends permit chain or conduit suspension and tilting to desired angle. Auxiliary equipment includes ballast, compensator, and starters assuring a power factor of not less than 95 percent and elimination of objectionable flicker it is said. Removable starters are mounted in the lamp sockets. Knockouts are provided in each end for ½-in. conduit and for switch.

Fixtures for one 18, 24, 36, or 48-in. fluorescent lamp are available in pendant and bracket styles. The former may be joined in parallel and linear groups, the latter provides for adjustable mounting. Supplied with and without ballast and starter. Goodrich Electric Co., 2900 North Oakley Ave., Chicago.

Worm Speed Reducer

Units of the Type 2⅝ A intermediate line of reducers weigh 22 lb. each, have a base dimension of 7½ by 5 in. and a height of 7 inches. They are capable of handling inputs from ¼ to 2 hp. at 1,800 r.p.m., and ⅛ to 1½ hp. at 1,200 r.p.m. Ratios range from 4 5/6 to 1 to 100 to 1. Worms are made of alloy steel with hardened and ground threads. Nickel bronze is used in the worm wheel. Oil seals are used on input and output ends. The output shaft can be made to project either right or left hand, or input and output shafts can be made to project at both ends. Abart Gear & Machine Co., 4832 West 16th St., Chicago.

Vertical Single-Phase Motors

Sizes ¾ to 5 hp. can be operated in isolated localities where small pumping units are used. Features: Design that protects against dripping and splashing; quiet operation; moisture, oil, and acid-resisting insulation. Solid shaft units are direct-connected to a pump or machine through a flexible coupling. Hollow shaft unit is adaptable to vertical pump applications as the pump shaft extends up through the motor shaft instead of joining with a coupling. Operating speeds: 1,200, 1,800 and 3,600 r.p.m. Those operating at 1,800 r.p.m. and less are of the repulsion-start induction-run type. The 3,600-r.p.m. motor

starts as a repulsion motor and the squirrel-cage winding in the rotor picks up a large portion of the load. Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago.

Machinist's Bench

All-welded steel construction is said to provide lifelong rigidity without periodic tightening. Top is ⅛-in. steel, shelves are 14-gage steel, legs are heavy angle steel. Finished in baked-on machine-gray enamel, can be equipped with a lock drawer, and can be furnished in any size. Stackbin Corp., 50 Troy St., Providence.

Treadle Rolls

Treadle-roll ball bearing for loom operation is made of high-carbon chrome alloy steel, heavily built to absorb shock, protected from dirt or lint, lubricated for long life. It is said to practically eliminate shutdowns for roll replacements, to roll easily, to not rub at the sides of the treadle arm. New Departure, Division General Motors Corp., Bristol, Conn.

Protective Hand Cream

Skin-Foil protective hand cream spread over the skin is said to provide a film of low surface tension, to remain stable in the presence of most chemical agents, is not transferable from hands to other objects, will not dry the skin, will not break up nor allow penetration of chemicals through itself, is slightly absorbed into the skin, fills hair follicles, is insoluble in water but comes off with soap. The Cromo Laboratories, 57 Monroe St., Garfield, N. J.

Magnetic Pulley Separator Unit

Unit combining two magnetic pulley separators is for use in smelter plants, in separating brass and iron turnings and borings. Material is fed into the bulk hopper with louver-type feed or into a chute below. Upper magnetic pulley unit picks up the coarse material, lower unit serves as a refining or secondary separation. Though the material have copper, brass or other coating, the units will auto-

THE CABLE KING HOIST BRINGS YOU ALL THESE FEATURES:

1. Air-cooling
2. Lifetime gearing
3. "Precision" type bearings
4. Self-adjusting load brake
5. Heavy duty motor brake
6. Weather-proof motor
7. 30 Minute motor rating
8. One point lubrication
9. Large diameter drum
10. Upper limit stop
11. Safety bottom block & hook
12. All-weather controllers
13. Ribbed steel hoist frame

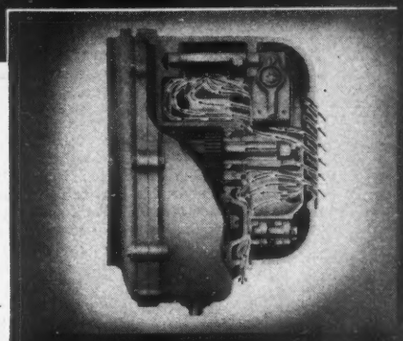
These features make the Cable King the electric hoist that meets *all* specifications engineers demand. A proved hoist . . . it's proved by exhaustive laboratory and field tests.

Air-cooling, an exclusive Cable King feature, eliminates excess brake heat, and enables the Cable King to operate on a heavier duty cycle than any other hoist in the same class. It accomplishes more in a given operating hour, which means greater savings.

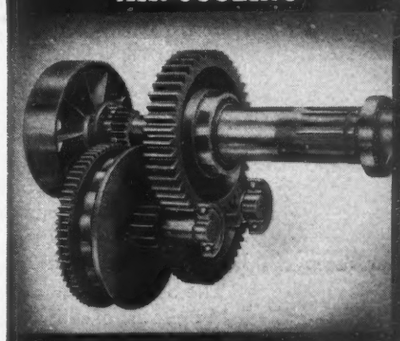
Another Cable King feature is Yale precision construction. All gears and pinions are drop-forged, chrome nickel steel, heat treated for maximum wear and long life. And the bearings at *all* friction points are "precision" ball or roller type, specially sheathed and shielded from dust.

These are only a few of Cable King's exclusive features. Ask your Yale distributor to tell you about *all* of them. Or write direct to us for descriptive catalog.

Capacity ¼ to 6 tons.



AIR-COOLING



LIFETIME GEARING

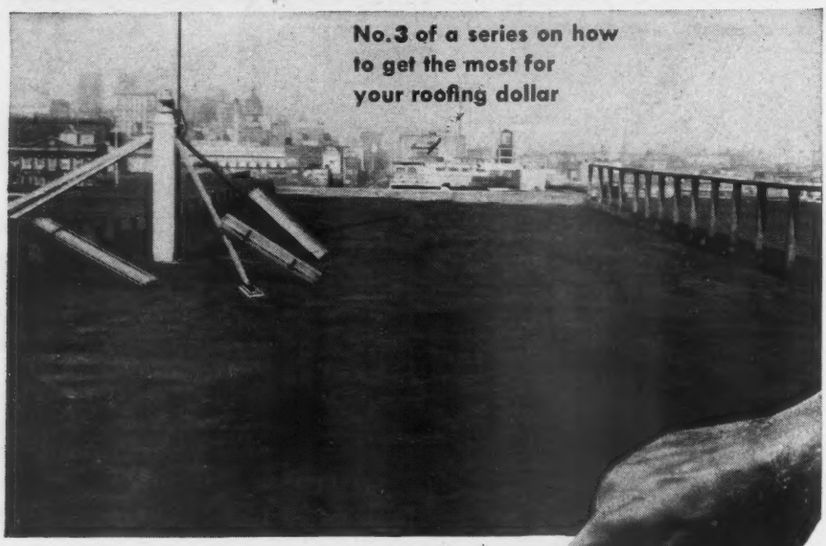
PRECISION TYPE BEARIN(

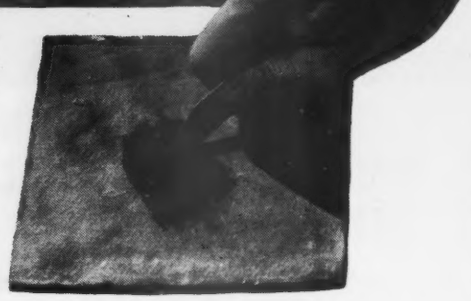
THE YALE & TOWNE MFG. CO.
PHILADELPHIA DIVISION, PHILADELPHIA, PA., U. S. A.
IN CANADA: ST. CATHARINES, ONT.

YALE

Makers of Yale Hand Chain Hoists, Electric Hoists, Electric Industrial Trucks, Hand Lift Trucks and Skid Platforms.

HOW TO TELL A GOOD ROOF





After 27 Years **this J-M Built-Up Roof—bonded for 20 years—is still sound... looks good for years to come. Installation is for Gantner and Mattern, San Francisco, Calif.**

No Periodic Coating **is ever needed with J-M Asbestos Roofs. They're *self-surfacing*. Scratch the weathered surface of a J-M Roof and you'll find black asphalt beneath. You can repeat this test a dozen times in the same spot with the same results.**

A GOOD ROOF WON'T ROT OR DRY OUT

DAY IN AND DAY OUT, two destructive enemies of built-up roofs are at work—sun and weather. But when you specify a J-M Built-Up Roof, *you can forget them!*

The asbestos fibres that make up J-M Felts are of solid construction... not capillary like ordinary roofing felts. Vital protective oils are actually locked in J-M Felts . . . can't possibly be sucked out by the parching sun. And because these same asbestos fibres are entirely mineral, they cannot rot . . . are 100% fireproof.

Far more important than any roofing bond is the "safety factor" built into every J-M Roof. A bond doesn't protect you from costly damage to building structure or equipment...but a J-M Built-Up Roof does. At every vital point, J-M specifications provide extra protection against failure... are *engineered* to give longer, lower-cost service under any conditions.

• • •

For all the facts on these better built-up roofs, write Johns-Manville, 22 East 40th Street, New York, N. Y.

JM PRODUCT

JOHNS-MANVILLE

ASBESTOS **Built-Up Roofs**

The Roof with the Safety Factor

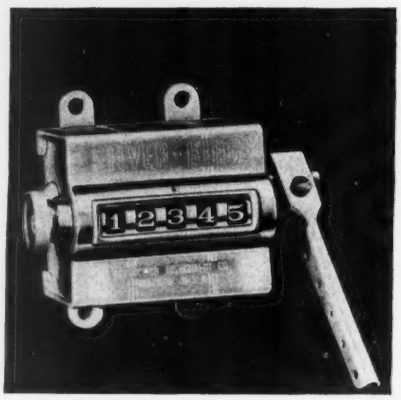
matically separate the iron and steel from the non-ferrous metals, it is said. Winch raises and lowers the upper unit to accommodate various sizes of materials treated. Casters can be furnished for moving the unit about. Available in various sizes and combinations, with or without winch feature. Stearns Magnetic Mfg. Co., Milwaukee.

Dust and Spray Hoods

For respirator and head protection on dust and spray operations, boiler cleaning, spray painting. Features claimed: Made of strong weave cloth, is fitted with respirator and laminated safety lenses in demountable rings, has replaceable parts. May be disassembled for washing. Industrial Products Co., 800 West Somerset St., Philadelphia.

Mechanical Counter

Silver King counter features bakelite number wheels to lessen the weight that must be started and stopped with every



count, steel base and cover for endurance and strength, unbreakable windows of reinforced plastic material streamlined to avoid shadows, chromium plating for easy cleaning. Production Instrument Co., 702-10 West Jackson Blvd., Chicago.

Oil-Pressure Unit

Designed to circulate lubricating oil at uniform pressure, this unit supplies oil through lantern glands of stuffing boxes, through large bearings, to hydraulic equipment, to heat-treating systems. The regulator is adjustable by hand and provides circulation at uniform pressure from 500 to 1,000 pounds. Cooling coil maintains uniformity of temperature and viscosity. Cylindrical filter within the cooling coil keeps grit or scale from entering the pump. Outlet is provided for relieving pressures or vapors from the tank without removing lid. Unit may be supplied complete or as a motor-pump assembly with motor, coupling, and pump mounted on the base. Durametallic Corp., 2104 Factory St., Kalamazoo, Mich.

Electric Lift

Industrial electric lift with capacity of 7,500 lb. lifts a load up to 5 ft. and is used between trucks and shipping room floors,

in lifting materials to machine level, and in place of ramps and skids. Can be installed on any floor of a building, it is said, as it is self-contained; can be moved about; has support posts which bolt to the floor. Consists of four tubular steel posts, steel platform raised and lowered by steel cables, and an electric motor-driven drum assembly. Two platform sizes: 6½ by 8 ft. and 6½ by 16 feet. Walker Mfg. Co., Racine, Wis.

Alloy

Tungsten-titanium carbide alloy, Kennametal K3H, combining toughness and hardness, is recommended as a tool-tip material for light finishing cuts and for fairly heavy continuous cuts on steel of hardnesses up to 550 Brinell. Said to have a hardness of 79.0 Rockwell C and a strength of 210,000 lb. per sq. in. on the transverse rupture test. Available in three standard shapes, in special shapes to fit specifications. Tools on which tips have already been brazed are also furnished. McKenna Metals Co., Latrobe, Pa.

Toolroom Bench Lathe

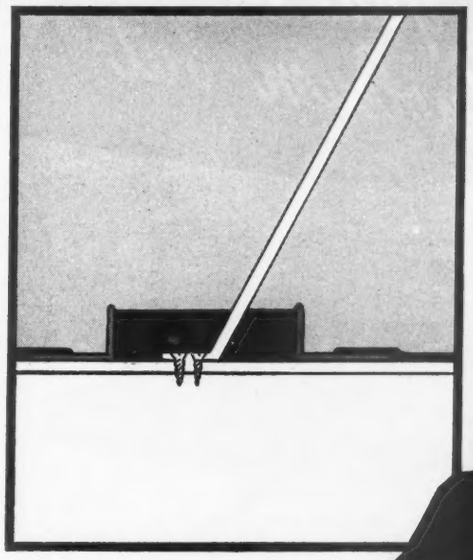
Ten-inch toolroom bench lathe for precision operations on small work has 1-in. maximum collet capacity. Headstock has 1 ⅜-in. capacity through the spindle and can be equipped with hand-lever or handwheel type draw-in collet chuck. Twelve spindle speeds ranging from 50 to 1,375 r.p.m. are available. Quick change gear

mechanism provides power longitudinal carriage feeds rated at 0.0015 to 0.0836 in., power cross feeds 0.0006 to 0.0313 in., and a series of 48 right and left hand screw threads from 4 to 224 per inch. Power feeds are controlled by a multiple-disk friction clutch. Lathe mounted on a tabular steel bench is made with bed lengths of 3, 3½, 4 and 4½ ft., center distances of 16⅜, 21⅜ and 34⅜ in. respectively. South Bend Lathe Works, 425 East Madison St., South Bend, Ind.

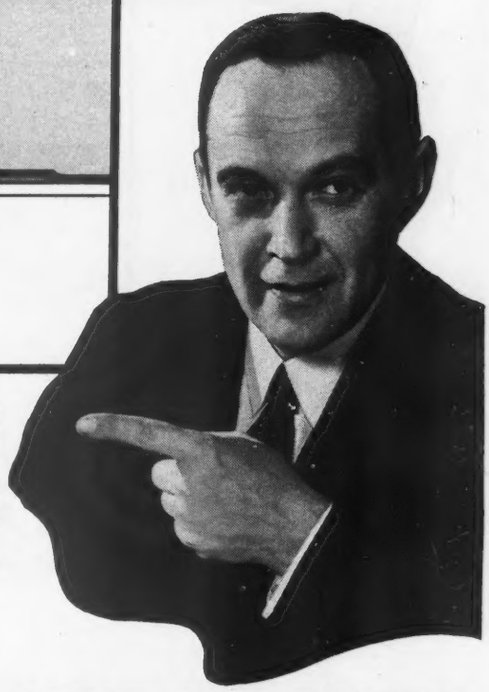
Roof Ventilating Fans

Recommended where necessary to increase air removal in gravity-type ventilators or when wind-mile velocity is not sufficient to ventilate a building. Fans are

HOW TO TELL A GOOD ROOFER



No. 3 of a series on how to get the most for your roofing dollar



Angle Supports are just one of many vital points on a roof that a J-M Roofer knows exactly how to protect from possible leaks. Every Johns-Manville Approved Roofing Contractor is thoroughly trained and experienced in J-M methods of roof construction. He'll make sure your J-M Built-Up Roof far outlives any ordinary roof.

A GOOD ROOFER WATCHES ALL THE "ANGLES"

EVERY BUILT-UP ROOF has at least 5 "vital" spots. And every one of them is where the roof forms an angle with some vertical surface such as a skylight.

Your J-M Approved Roofer knows exactly how to construct a Built-Up Roof that eliminates failure at such spots. He rigidly follows the specifications J-M Engineers have carefully worked out to assure all the necessary protection at each of these critical points. That's why you find hundreds of J-M Built-Up Roofs giving excellent service long after their bonding period has elapsed.

Before any J-M Roofing Contractor is ever approved, he must give ample proof that he completely understands J-M roofing methods . . . that he will follow J-M's rigid specifications to the letter.

• • •

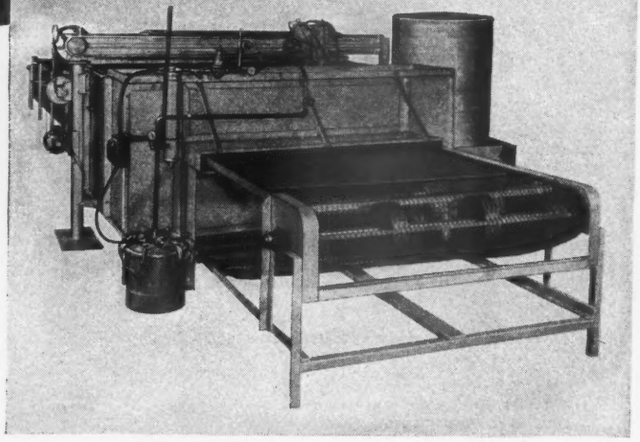
For the name of the J-M Approved Roofing Contractor nearest you, see your classified telephone directory or write directly to Johns-Manville, 22 East 40th Street, New York, N. Y.

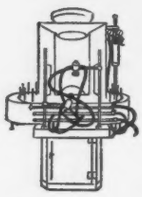
JOHNS-MANVILLE JM PRODUCTS

APPROVED Roofing Contractors

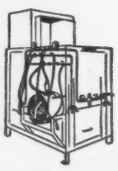
Selected for their Ability and Integrity

Perhaps you don't make linoleum but-





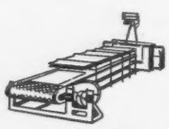
Rotary



Pipe Coating

. . . . Coating Automatically 480 Square Feet a Minute May Give You an Idea!

Horizontal Transverse



Swinging Arm

Heavy Duty Rotary

Gang Spray

● This manufacturer sprays, dries and cools a wax emulsion on linoleum at a rate of 28,800 square feet an hour. It's done with a DeVilbiss Automatic Machine—and a puzzling cost problem has been solved.

The DeVilbiss line of automatic spray equipment includes machines of standard types which can be adapted to almost every finishing need. They perform such jobs as painting 200 feet of pipe a minute; applying 3 coats of latex and silicate of soda to 1200 pads each hour; finishing 3500 electric fan parts hourly. DeVilbiss Machines spray products of all sizes and shapes—at top speed and at lower costs.

WHAT'S YOUR PROBLEM? A DeVilbiss Spray Specialist can show you a profitable solution quickly. If automatic spraying is the answer, it is more than likely a standard DeVilbiss machine can be adapted to your job. If your product finishing requires hand operations, but needs more speed and efficiency, the answer is still DeVilbiss. Write today.

THE DEVILBISS COMPANY • TOLEDO, OHIO

Canadian Plant: WINDSOR, ONTARIO

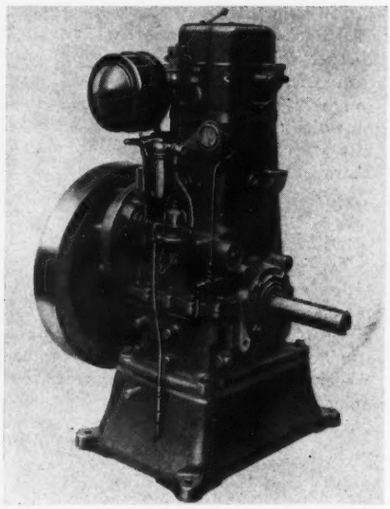
THE COMPLETE DEVILBISS LINE CONSISTS OF: Spray-finishing equipment . . . Automatic coating machines . . . Tanks for spray materials . . . Spray booths and exhaust fans for vapor and dust elimination . . . Air regulators, cleaners and dusters . . . Air Compressors . . . Respirators . . . Specialized hose for paint, air, water, gasoline, welding and pneumatic tools . . . Hose connections . . . Water and oil guns . . . Equipment to prevent offset in printing . . . Paint stripers . . . Medicinal atomizers . . . Perfume atomizers.

DEVILBISS SPRAY SYSTEMS

mounted in steel bands; propellers are made of cast-aluminum alloy; motors may be had in open, totally enclosed non-fan-cooled, totally enclosed fan-cooled, and explosion-proof types. Available in 48, 42, 36, 30, 24, and 18-in. sizes with air exhaust capacities ranging from 40,000 to 2,000 cu.ft. per minute. Inside diameter of ventilating stack and amount of air to be delivered determine the proper size. Truflo Fan Co., 519 Main St., Harmony, Pa.

Small Diesel Engines

Line of diesel engines equipped with the Lanova combustion chamber is available with four sizes and a variety of mountings. The 7½ and 10-hp. models are



single cylinder. The 15 and 20-hp. models are twin cylinder. The latter have No. 1 Bell housing with enclosed flywheel. The Stover Manufacturing & Engine Co., Freeport, Ill.

D.C. Wattmeter

Operates from a standard 50-millivolt ammeter shunt. The magnetic field is produced by an electromagnet energized from the line voltage. The magnetic circuit is made from an alloy of iron and nickel. Existing shunts and long small wire shunt leads may be used for the current circuit of these wattmeters. Available in 5½-in. square or 7½-in. round switchboard cases. Principal application is to variable-voltage d.c. power circuits or control. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Tubular Dust Collector

For use where space is small. Can occupy approximately the space of a horizontal flue, can be built in connection with a vertical flue or directly beneath an air preheater. Construction features: 6 or 9-in. tubes have long narrow slots acting as inlets and are equipped with directional guides to provide smooth tangential flow of gas into the tubes; group of tubes within inlet plenum chamber have low velocity such that energy used for passage of gas through apparatus may be converted practically 100 per cent into centrifugal force;

POP'S ALL PRIMED TO POP!

MY PORE OL' GRAMMA COULD SMOOTH DOWN A HAMBONE WITH HER BARE GUMS FASTER THAN WHUT IKE'S DOIN' ON THAT CASTING WITH THE WRONG TYPE FILE!
TAKE A GANDER AT POP WHO SAYS SOME CONKS GET THE IDEA THERE'S ONLY TWO KINDS OF FILES-- FILIN' FILES AND CARD-INDEX FILES!
WILL SOMEONE PLEASE HAND IKE A NICHOLSON FOUNDRY FILE BEFORE POP SCUTTLES HIS BLOOD-VESSELS!
PLAY SAFE-- WORK SAFE!

NICHOLSON Files for every purpose, is no empty phrase. With more than three thousand types, shapes and sizes, it definitely means that every Nicholson or Black Diamond File is *The RIGHT file for the job.* . . . Right in design, weight, cut, balance, "feel," hardness—and with each of these qualities so uniformly maintained that Nicholson can safely guarantee *Twelve perfect files in every dozen!*

Take foundry files: First developed for snagging castings, Nicholson and Black Diamond Foundry Files are carefully designed for removing fins, sprues and other hard projections; for filing narrow edges and sharp corners of dies, etc.

They're tough! They've extra-strong, rugged teeth; heavier set edges. Made to resist shelling off or breaking out, for fast stock removal . . . for long life and money saving! Regularly in bastard cut—Flat, Half-round, Round and Square—8" to 18". Each file plainly stamped "Foundry" for ready identification.

NICHOLSON FILE CO., Providence, R. I., U. S. A.
Alta Canadian Plant, Port Hope, Ont.

NICHOLSON FOUNDRY FILE. *(Stamped "Foundry" on side opposite trade-mark)*

NICHOLSON FILES

FOR EVERY PURPOSE

NICHOLSON U.S.A. MADE IN U.S.A.

EAGLE
BEARING METALS

DREADNAUGHT —for extreme speed and pressure conditions

OUTLASTA —for medium speed and pressure conditions

DURABLE —for low speed and pressure conditions

THESE 3 METALS MEET MOST BEARING REQUIREMENTS Order from your jobber

* 1. Only clean, primary metals are used.

2. Alloying process is under strict pyrometric control.

3. Casting temperatures are exactly controlled.

EAGLE SOLDERS—a complete range of fusion and melting properties—to give economical performance on any kind of industrial solder job.

EAGLE EP PICHER

EAGLE TIN-LOY is an ideal tinning compound that assures an effective lasting bond between bearing metal and the shell. Easy to use—efficient—economical.

THE EAGLE-PICHER LEAD COMPANY
CINCINNATI, OHIO

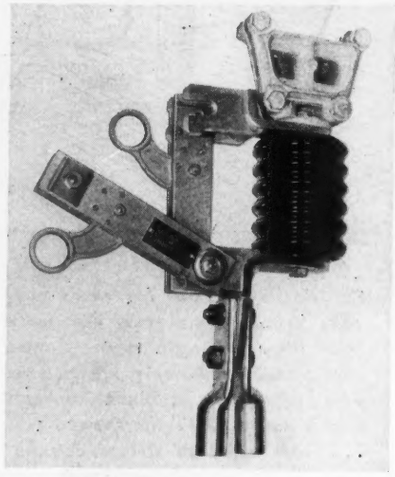
cone at bottom of centrifugal tubes, is eliminated; 4½-in. central tube separates clean gas whirl from dust-bearing outer whirl by a wall and forms an annular space ¾ in. wide between central tube and outer tube; tubes are within gas stream to avoid moisture precipitation and resulting corrosion and possible plugging; special materials are used where corrosion or abrasion may occur; sectional tubes without bolted joints facilitate removal and replacement; equi-spaced tube sheets and spacing of tubes insure against recirculation. Installations for individual boilers range up to 10,000 horsepower. Prat-Daniel Corp., Port Chester, N. Y.

Threaders for Small Pipe

Ratchet and three-way threaders for small pipe, all-steel malleable alloy construction, are available in five models. Three are for ⅛ to 1¼-in. pipe: No. 00R die heads are locked in or removed by pull of ratchet knob, Nos. 0R and 11R die heads push out for changing and snap into ratchet ring from either side. Same dies are used for threading pipe close to the wall. Electrical conduit dies are available. Carrier holding ratchet ring and set of dies comes with complete sets. Nos. 30A and 31A three-way threaders have double ball-end handles. They thread pipe from ⅜ to 1 inch. The Ridge Tool Co., Elyria, Ohio.

Disconnecting Switch

Clamps directly on the busbar and offers a convenient oil-breaker disconnect for open-type switchboards. Features: Tongue-



type full-floating blades, line-pressure contacts, annular-ring line-pressure hinge, bolt-type lock between contact and hinge to preserve headroom. Ratings: 7,500 and 15,000 volts; 400, 600, 800, and 1,200 amperes. (The 400 and 600-amp. switches have single blades). Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

Locknut

Self-contained one-piece all-metal Ancor-lox locknut locks automatically to the bolt. It is spun on the bolt and drawn up tight. Metal locking ring contained in the bottom of the nut is expanded by

"Come on, Mr. Buyer... I'll lead you right to the nearest dealer"
YOUR LOCAL TELEPHONE DIRECTORY
CLASSIFIED TELEPHONE DIRECTORY
Water Coolers
GENERAL ELECTRIC WATER COOLERS—
A complete line of water coolers to meet every requirement. Pressure and bottle types. General Electric designed and built...your assurance of quality.
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McGARREY-GREGER
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NORGE WATER COOLERS—
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24 & Walnut sts LOC ust-7555
Pure Filter Co 1217 Market.....LOC ust-3810
From 5 30 PM to 8 AM weekdays
& on Sundays & holidays ask Operator for Collingswood-2540-M
(See Advertisement This Page)
Rosenau Richd P 1217 Mkt st....LOC ust-3810
Water Co 205 S 10....WAL nut-2511

Find what you want *quickly* . . . in your Telephone Directory

When you want supplies, parts or service in a hurry, reach for your telephone book and turn to the 'yellow pages' — the Classified Section.

There you will find many brand names listed together with the authorized representatives to serve you, see example above. You will also find almost *every* business or service in your locality, with buying information to help you choose the ones you want. A telephone call puts you in touch without delay.

More and more, industry is using the Classified Section of Telephone Directories both to *buy* from and to *sell* through.

A Bell System representative will be glad to explain the advantages of this service to *your* company. Just call your local telephone office.

THE OLYMPIAN

—an R.L.M. closed-end Fluorescent fixture; assures proper light control. Reflector and hood are separable. Uses two 48" fluorescent lamps.

Why YOU SHOULD DEMAND PORCELAIN ENAMEL FINISH

FREEDOM FROM REFLECTED GLARE

—ample diffusion of light eliminates all trace of reflected glare common to specular finishes.

PERMANENT—WEATHERPROOF

—can never corrode or tarnish to impair lighting efficiency; unaffected by atmospheric conditions.

EASY TO CLEAN

—reflector can be easily cleaned by merely wiping with a damp cloth to maintain full reflecting efficiency.

GOODRICH FLUORESCENT FIXTURES

Offered in a variety of sizes and styles for general and local industrial illumination. Reflectors and hoods are separable for easier wiring, installation, and maintenance. All Goodrich fluorescent fixtures are finished in vitreous-fired porcelain enamel. All are furnished complete with ballast equipment, replaceable starters, and adjustable brackets for chain or conduit mounting. Catalog sheets on request.

AVONDALE

—open-end fluorescent fixture. Uses two 48" lamps.

HILLCREST

—apertures direct a portion of light towards ceiling. Uses either two or three 48" lamps.

SOLD ONLY THROUGH ELECTRICAL WHOLESALERS

GOODRICH ELECTRIC COMPANY

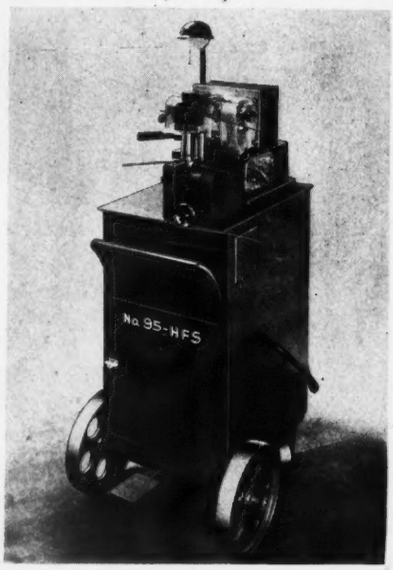
OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 4604 BELLE PLAINE AVENUE, CHICAGO, ILL.

locking pressure into root of bolt thread and against the nut rim. "Lock joint" is said to hold under heat and vibration, to be adapted to short as well as long bolts, to not damage the bolt thread or mar surface of the work, to be usable over and over again. Available in standard sizes and in a variety of metals. Laminated Shim Co., Inc., 64 Union St., Glenbrook, Conn.

Butt Welder With Burr Grinder

Portable butt welder, grinder, and annealer form one unit for welding metals from $\frac{1}{16}$ to $\frac{3}{16}$ in. in diameter. For welding other sizes of wire or metals, units are available with transformers from 1-7½ kva.



capacity. Wiring is concealed within the fabricated case, a draft tube is provided to remove grinding dust from vicinity of work. Welder is supplied with a 3-kva. air-cooled transformer and 8-point variable switch for current regulation. Unit is foot-operated and butt jaws can be water-cooled for continuous service. Eisler Engineering Co., 740-70 South 13th St., Newark, N. J.

Load Carrier

Light-weight electric truck KM-26 has a capacity of 3,000 lb. and may be loaded by hand, chain or electric hoist, overhead crane, or ship's tackle. Features: Frame of welded steel plate, small over-all dimensions, four-wheel steer, control platform protected by a streamlined bumper, cushioned foot pedals for operator's comfort. Its light weight permits use over gangplanks, floors, in elevators of limited capacities. Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia.

Electric Winch

Hoisting and lowering of loads are regulated by a two-station pushbutton control located on the hoist or at a remote station. Oversize magnetic disk brake built into the motor holds load when current is

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Railroads, metal-working industries, plant maintenance men, industrial builders... drill users seeking rugged construction, plus-powered motors and long life, chose from the wide Stanley line of Electric Drills. There's one just right for every job. Capacities: 3/16" to 7/8" in steel. Ask your Stanley distributor for demonstration, or write for literature. Stanley Electric Tool Div., The Stanley Works, New Britain, Connecticut.

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One pair of bare, 10-inch flanges at 350°F., waste one ton of coal per year.

One foot of bare, 10" steam pipe, heated to 700°F., can cost you heavy heat loss. Figuring steam cost at 30c per million B.T.U., insulation 3½" thick, shows an annual saving of $25.50 per foot of pipe.

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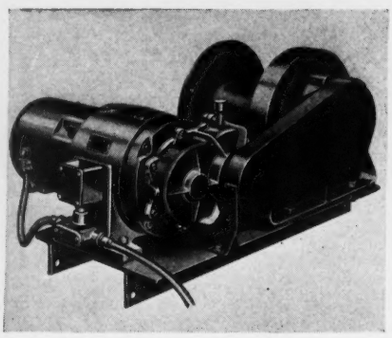
shut off. Lever on motor brake housing can be used to release magnetic brake. With automatic winch the drum, brake, pawl and ratchet, or shifting levers are eliminated. For manual operation, with installations requiring a free drum, they are furnished. A standard 1,200-r.p.m. motor without magnetic brake is used with this type. Both types are equipped with 1½ to 7½-hp. electric motors. Maximum single line speed recommended is 50 ft. per min.; maximum load, 4,000 lb. single line. Ramsey Machinery Co., 1626 N. W. Thurman St., Portland, Ore.



Portable Saw Table

Can be knocked down to be taken out on the job, set up, and used to convert the No. 85 Quick-Saw to saw-table use for ripping, mitering, beveling. Saw table of portable saw locks in place in center of table top and depth and angle adjustments on the saw can be made in saw-table use. Table is made of heavy gage metal with demountable legs, an adjustable ripping guide and clamps to hold saw in place. The Van Dorn Electric Tool Co., Towson, Md.

Disinfectant

Disinfectant, also a deodorant and fungicide, is non-poisonous when properly used; destroys obnoxious odors; is said to have a mild, pleasant quickly disappearing aroma and to not harm the hands or nails even when spilled on them full strength. Available in containers from 1-gal. cans to 55-gal drums. Bee Brand Disinfectant Division, The McCormick Sales Co., 724 McCormick Building, Baltimore.

Capacitors

Line of capacitors for power factor correction applications in fluorescent lamp circuits includes three types of Dykanol impregnated and filled units. They are sealed in steel containers for protection against atmospheric conditions. Type KF is available in seven values from 3-28 mfd. four rated at 240 volts, and the 6.5-, 11-, and 28-mfd. units at 120 volts. Type KS is furnished in 11 capacities ranging from 2-8 mfd. with container lengths varying from 3-6½ inches. It measures 1 by 2⅛ inches. Connection terminals are spaced ⅝ in. between centers. Rated for service

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What to do about the SNOOPER!

SNOOP (*snoop*), *v.i.* [*D. snöepen*]
To look or pry about in a sneaking or meddlesome manner; also to search pryingly for information, etc.—**SNOOPER** (*er*), *n.* one who snoops.
—*Webster's Dictionary*

NOW is the time to keep prying eyes away from your plant—to be sure that burglars, trespassers or others who have no business on the premises are kept out . . . to prevent the work of firebugs. It's too big a job for your watchman to do alone. But you can have a record of every man who enters your plant—and every piece of material that goes out when the watchman has the help of U·S·S Cyclone Fence.

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UNITED STATES STEEL

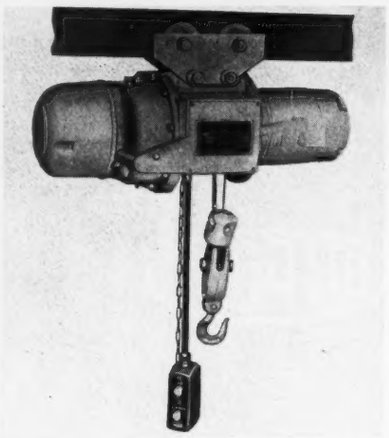
on 120-240 volts. Type KW is identical with Type KS except that it is $1\frac{7}{16}$ in. wide, $1\frac{1}{8}$ in. thick, and spacing between terminal centers is $\frac{9}{16}$ inch. Cornell-Dubilier Electric Corp., South Plainfield, N. J.

Merger

Callite Tungsten Corp., Union City, N. J., has announced acquisition of Harris Alloys, Inc. The business of the former Harris Alloys will be conducted as a division of Callite Tungsten Corp.

Electric Hoist

Load-King air-cooled wire-rope electric hoist has two capacities—$\frac{1}{4}$ and $\frac{1}{2}$ tons, and is available in three types—lug, hook, or plain trolley with right-angle or parallel suspension. Features: Standardized interchangeability of repair parts, small overall dimensions, ball and roller bearings. May be operated outdoors as well as within the plant, it is said. Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia.



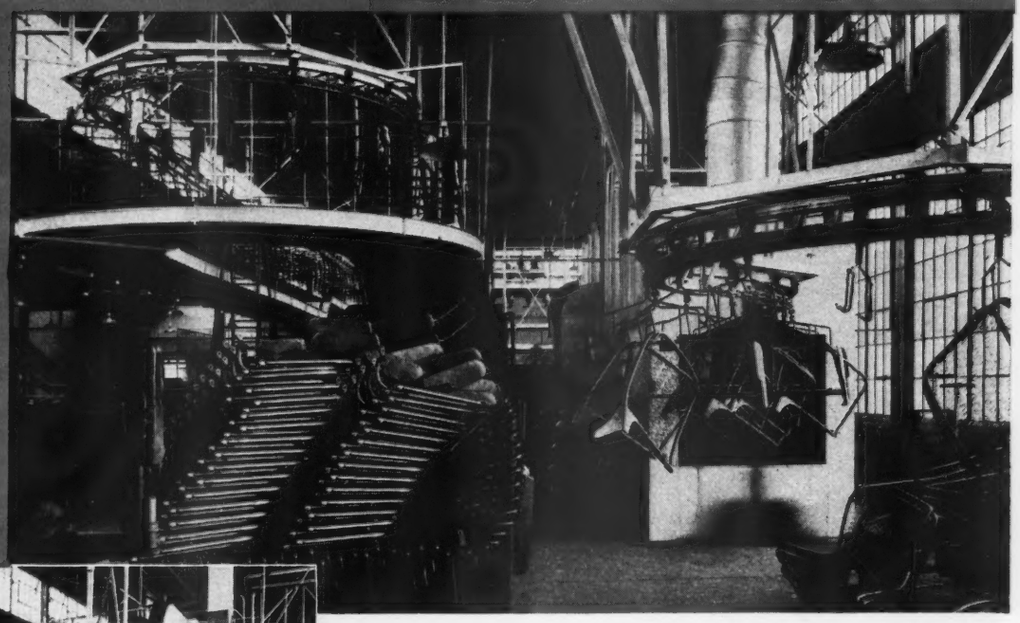
Adustable Bar Hanger

Bar-$\frac{3}{8}$-inch hanger permits installation of most styles of outlet, ceiling, and cable boxes and is useful for conduit, cable, or knob and tube work. Made in one unit without detachable parts for easier installation, it consists of a bar with $\frac{3}{8}$-in. sliding fixture stud and locknut, which permits adjustment of outlet box between joist or studding at proper height. Appleton Electric Co., 1701-29 Wellington Ave., Chicago.

Combustible Gas Indicator

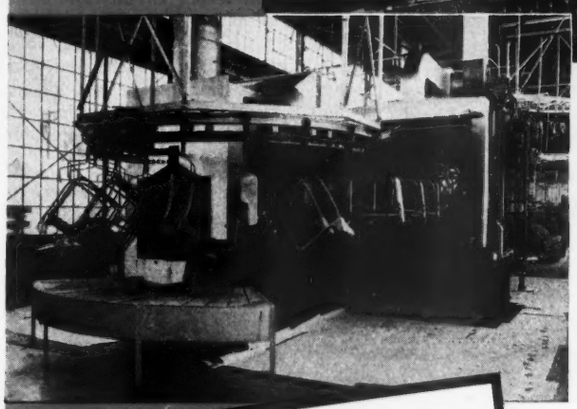
Explosimeter Model 2 has a simplified electrical circuit featuring a replaceable single filament and single control knob. One-hand operation leaves the other hand free to handle sampling line or probe. Flow system is cast integral with case thus eliminating tubings, built-in filter chamber is provided with cotton inserts to trap dust and moisture or with a charcoal cartridge that differentiates between illumi-

Cut FINISHING *Costs with Modern* EQUIPMENT

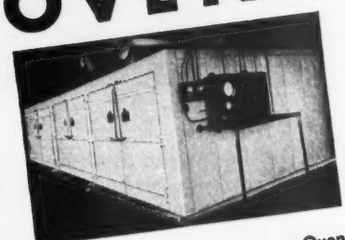


At right: General view of the complete Mahon Finishing System, installed at the American Metal Products Company's plant, Detroit, Mich.

Below: Products emerging from the Mahon Flowcoat Painting Machine and entering the Enamel Baking Oven—parts of the Complete Mahon Finishing System installed at the American Metal Products Plant, Detroit, Mich.



OVENS



Illustrated here is a box type Oven installed by Mahon for the Press Sign Co., St. Louis, Mo. The R. C. Mahon Company design and build Ovens of all Types to meet any temperature requirement. Embodied in the construction of these Ovens are many very desirable features from a standpoint of utility and long life. Details will be furnished on request. Write today.

. . . designed to do YOUR job Efficiently and Economically

The complete Mahon Finishing System installed at the American Metal Products plant in Detroit is a typical example of Mahon's thorough planning and advanced engineering in this highly specialized field . . . it includes Metal Cleaning, Drying, Painting and Air Drying Equipment coordinated into one system which is conveyorized and entirely automatic. A Mahon Flowcoat Painting Machine applies the finish in this particular installation. Today, when it's a question of Finishing Equipment, manufacturers turn their entire problem over to Mahon engineers with complete confidence—Why? . . . because they know that Mahon engineers, backed by seventeen years of research, development and practical experience in every industry where finishing is an important production operation, are better qualified to plan the type of installation best suited to their particular requirements. You can greatly improve the finish on your product, and reduce your costs too, with a thoroughly engineered, properly coordinated Mahon System. Call in a Mahon engineer today—consultation and study of your requirements will not place you under any obligation.

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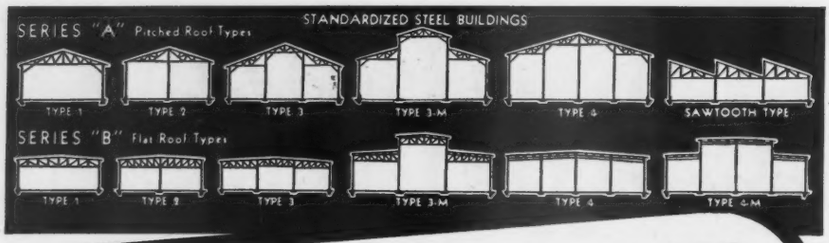
Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Ovens of All Types, Filtered Air Supply Units, Hydro-Foam Dust Collectors and many other Units of Special Production Equipment.

MAHON



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nating gas and condensable combustible vapors. Powered by standard flashlight batteries contained in a compartment separate from the working parts. On-off signal bar on the control knob rises when current is on and drops flush with knob when current is off. Weighs 4½ pounds. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh.

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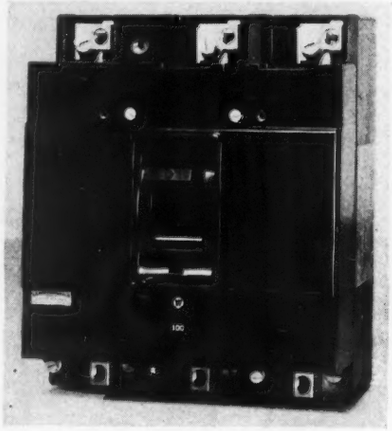
Heavy-duty Airline Lubriguns, designed to dispense lubricants directly from original 400-lb. refinery drums, are available in three types: High and medium-pressure models to handle lubricants ranging from heavy viscous to light fluid greases, low-pressure models to dispense all grades of fluid lubricants and lubricating oils. Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis.

Circuit Breakers

For panelboard, switchboard, or enclosure mounting with terminals and bases arranged for all three kinds. The breakers are rated at 50, 70, 90, and 100 amp. at 250 and 600 volts a.c., 2 and 3-pole; and 125 and 250 volts d.c. They are adaptable to lighting and feeder circuits and motor branch circuit protection. All the breakers use the 100-amp. frame for interchangeability. Adjustable magnetic trip permits close setting of breaker for any tripping current from 3½ to 11 times the breaker's normal rated current, and enables



the trip to be set in the field under actual service conditions to give maximum protection to the equipment. Inverse time thermal trip of bimetallic type provides adequate protection for light overloads. Special breakers are available with shunt and/or undervoltage trips. Westinghouse Electric & Mfg. Co., Department 7-N-20, East Pittsburgh.

Wire Rope Connector

Features vibration damping design, grips the cable with graduated compression, feathers off from maximum at rear to zero at front, is said to prevent "weak-point" crystallization at point of connection. Three units: sleeve that slips over end of wire

the records have been made

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Building	Location	Type of Roof	Service Years	Present Condition
Mill	Lawrence, Mass.	Coal tar pitch	46	Good
Mill	Lawrence, Mass.	Coal tar pitch	36	Good
Factory	Pawtucket, R.I.	Coal tar pitch	35	Excellent
Dye Shed	Pawtucket, R.I.	Coal tar pitch	27	Excellent
Warehouse	Omaha, Neb.	Coal tar pitch	23	Good
Store	Minneapolis, Minn.	Coal tar pitch	21	Good
Laundry	Omaha, Neb.	Coal tar pitch	21	Good
Office Building	Paterson, N.J.	Coal tar pitch	17	Good
Mill	Passaic, N.J.	Coal tar pitch	16	Good

If you are buying a roof for a new building . . . or a new roof on an old building . . . your best chance of getting long trouble-free service is by specifying coal tar pitch and tarred felt.

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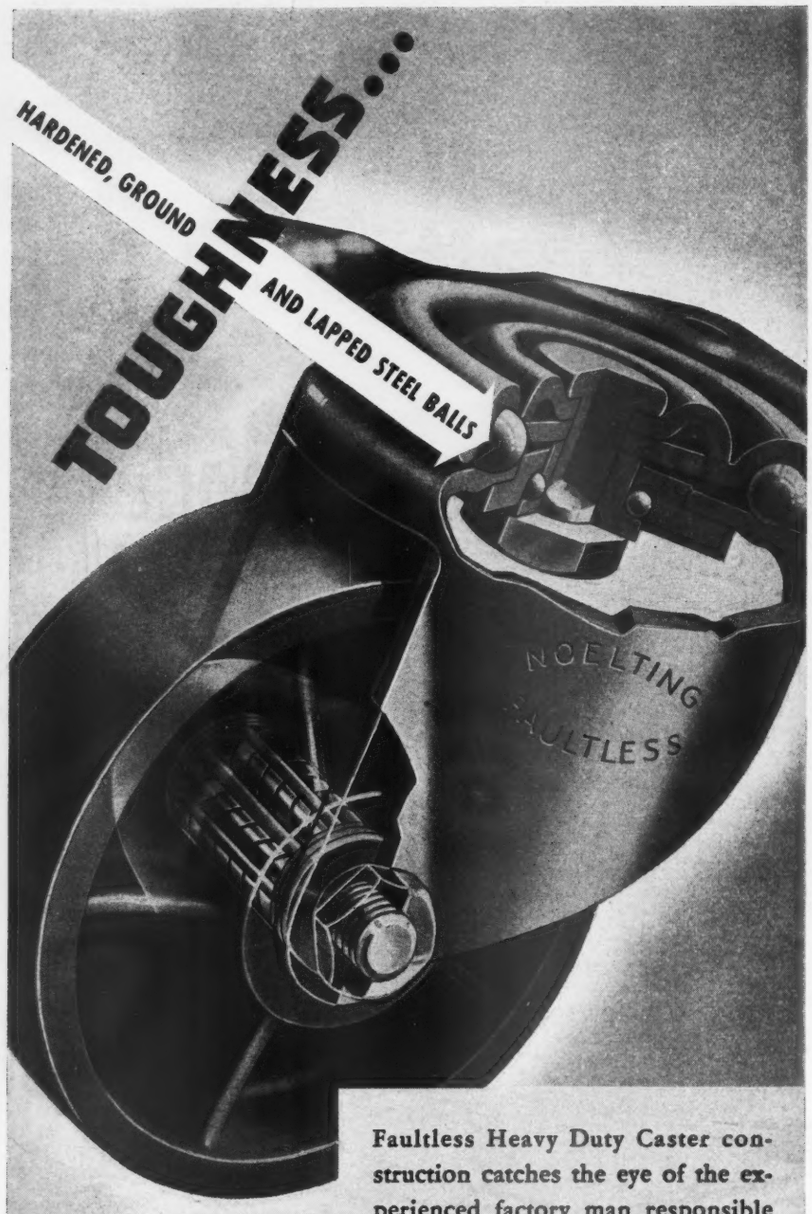

Faultless Heavy Duty Caster construction catches the eye of the experienced factory man responsible for factory transportation and its cost. In this caster, strength is not achieved at the expense of easy mobility. In fact, here is a caster so scientifically designed and proportioned that it not only gives longer service but makes the moving of heavy loads a considerably lightened job.

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★ A large diameter, genuine Hyatt Roller Bearing in the wheel assures easy rolling action.

★ The horn is of extra heavy gauge steel and the fracture-proof semi-steel wheel is available either plain or with rubber tread.

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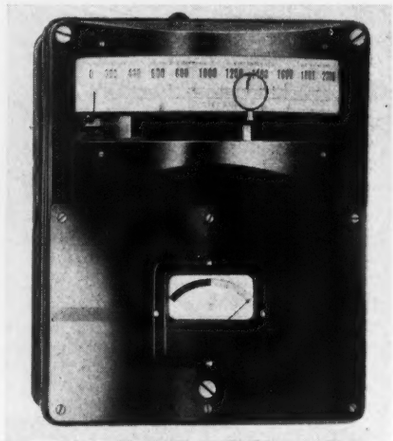
FAULTLESS CASTERS

rope, tapered plug that is inserted to separate and hold strands of wire in sleeve, covering socket that locks the cable. An "inspection hole" enables workman to judge the perfection of the twist joint. Available for sizes ¼ in. up in black, hot-galvanized, and cadmium-plated finishes; ½ in. and smaller in black, hot-galvanized, and cadmium-plated steel and in bronze, stainless steel, and monel metal. Electroline Co., 4073 South LaSalle St., Chicago.

Pyrometer-Controller

Control of an electronic pyrometer controller that eliminates moving parts in the control circuit is accomplished by an electronic circuit using a single high-output vacuum tube, all-metal type. Milliammeter on front of instrument indicates condition of control circuit at all times. Fea-



tures claimed: Pointer of the millivoltmeter movement, not engaged or retarded at any point within normal operating range, permits continuous indication of temperature under control; controller, due to the Millivac Relay, is sensitive to changes in temperature at the thermocouple; operating mechanism of the relay is enclosed; measuring unit is equipped with a cold-end compensator. The Bristol Co., Waterbury, Conn.

Safety Valve

For hot water heating boilers. Features snap action with two positions—when pressure reaches 29 lb. it snaps wide open and stays open until pressure drops to 22 lb. when it snaps to a leak-tight closure, thus preventing pressure above 29 lb., it is said. Stainless-steel cone, a bellows that operates the valve, metal-to-metal seat above the cone that seals water away from working parts are other features. McDonnell & Miller, 1314 Wrigley Building, Chicago.

Medium-Spread Floodlight

Alzak aluminum floodlight with 90-deg. spread is for use in industrial yards, service stations, parking lots. Features: Waterproof cover protects lamp and reflecting surfaces against rain, moisture, dust, dirt, fumes, smoke and is hinged at top and secured to floodlight reflector by a series of

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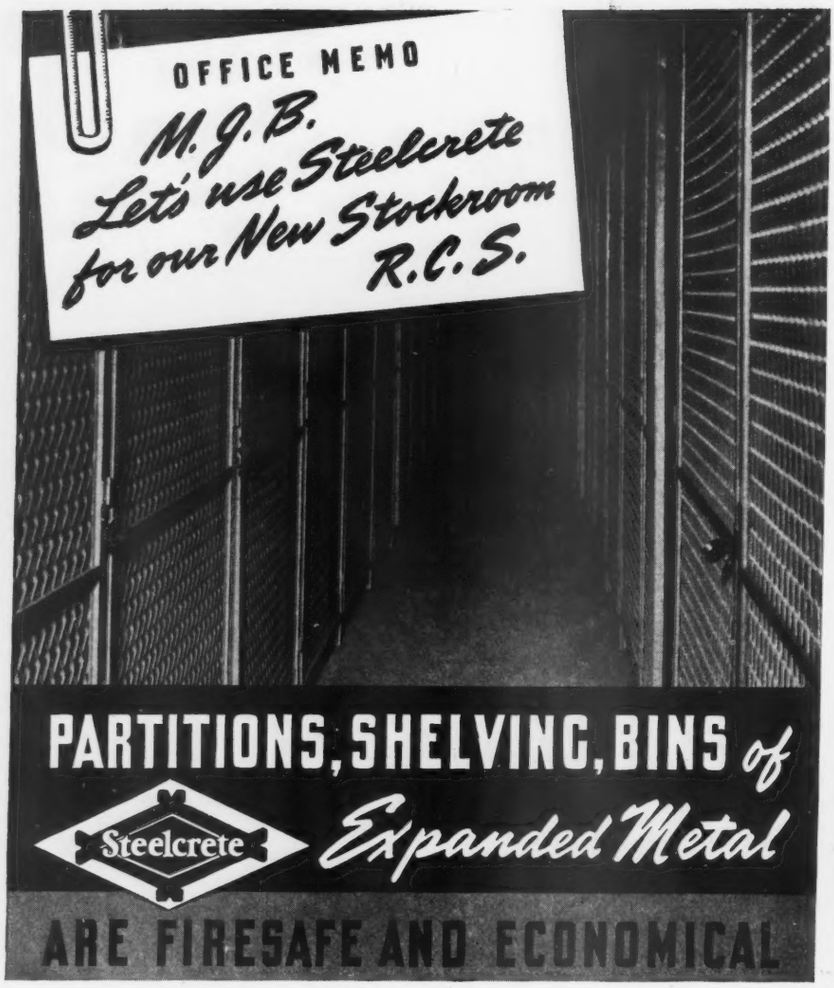

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STEELCRETE EXPANDED METAL is low in cost and offers many advantages in the building of partitions, shelving, guards and other improvements in the plant. This rigid material with its open diamond mesh can be readily fabricated into strong, clean, attractive partitions that allow good distribution of light and air. Lightweight and flexible it is easily shaped to fit any specification. Available in a large range of gauges and sizes including several new meshes, as well as standardized units and fittings or completely fabricated ready for erection. Send for Steelcrete Handbook which shows numerous uses.

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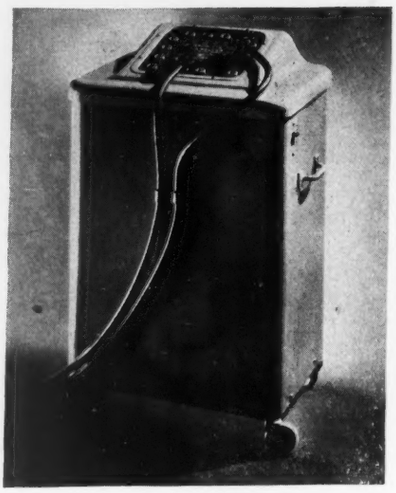
hand clamps around the rim; glass is secured in cover frame to prevent accidental dropping out; knife-edge lip in reflector serves to compress cover gasket and seal the opening; vertical stop is incorporated in crossarm mounting bracket by which floodlights may be tilted back over crossarm for servicing. Benjamin Electric Mfg. Co., Des Plaines, Ill.

Extension Spray Gun

Type EX extension spray gun is for painting large surfaces beyond natural reach of the operator not using scaffolding and staging. Supplied in lengths up to 12 feet. Detachable gun grip control permits use of different lengths of shaft. The shaft turns in the grip so that spray can be in any direction. Spray head is supplied in two standard models. Eclipse Air Brush Co., 300 Park Ave., Newark, N. J.

Continuous A.C. Arc Welders

Two models: No. 160 with current range of 15-160 amp., No. 250 with current range of 15-250 amperes. Operate on single phase or on one phase of two or three-phase current. Features claimed: Current



required at "no-load" never exceeds 50 watts, controls and sockets are placed on top on a sloped panel to eliminate stooping or crouching in selecting heats or making adjustments, heats may be selected in gradual steps over a wide range. Employing a broken wave current produced by a special winding, the welders are said to be stable in operation and to produce smooth uniform beads and fillets. Ergolyte Mfg. Co., 3644 Lawrence St., Philadelphia.

Fluorescent Trough Lighting

Fluorescent Troffers for general overhead illumination of offices, factories, drafting rooms, and ceilings having acoustical or hung-ceiling constructions recess in the ceiling individually or in continuous row formations. The reflectors attach to wireway channels by screws and cushioned washers after channels are installed in ceiling and wiring is completed.

Bassick TRUCK CASTERS

SIZES and TYPES FOR EVERY REQUIREMENT

Many materials handling problems require casters which can be placed in service and forgotten, without worry as to where they will go or what loads they will be required to carry.

Bassick Heavy Duty Casters are supreme in quality and operating efficiency. They are practically indestructible, perpetual casters—the quality leaders of over 500 sizes and types of Bassick Truck Casters designed to serve your requirements economically.

FOR FURTHER INFORMATION
SEE OUR CATALOG IN SWEET'S

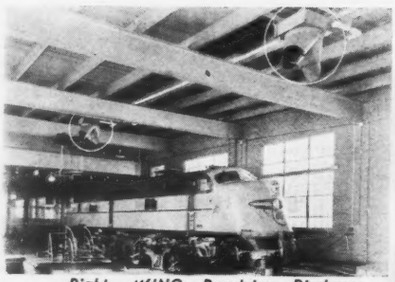
THE BASSICK COMPANY • BRIDGEPORT, CONNECTICUT

Canadian Factory: STEWART-WARNER-ALEMITE CORPORATION OF CANADA, LTD., BELLEVILLE, ONTARIO

THE AIR AT CEILING IS DRAWN THROUGH HEATING ELEMENT AND PROJECTED THROUGH REVOLVING DISCHARGE OUTLETS TO WORKING LEVEL
WING
DISCHARGE→OUTLETS→REVOLVE→SLOWLY

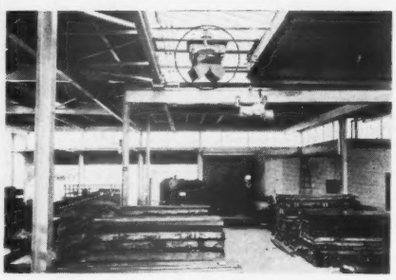
THE NEW SYSTEM OF PLANT HEATING

Slowly revolving outlets . . . an innovation which assures THOROUGH heat distribution . . . a sensation of heating comfort never before attained . . . the air feels alive and invigorating.



Right — WING Revolving Discharge Heaters in Prize-Winning Plant of Mohican Steel Company, Glendale, L. I., N. Y.

Left—Chicago & North-Western Railway Co. selected WING Revolving Discharge Heaters because they are as modern as the streamlined locomotive.



NO other single factor is more important than heating in assuring comfort to factory workers who will be "under pressure" this Fall and Winter, due to National Defense programs. Comfortable working conditions are not left to chance when the WING System of Heating is adopted in a plant.

WING Heaters provide the utmost in comfort in plants like General Motors, Linden, N. J., Wright Aeronautical Corp., Paterson, N. J., Dodge Truck Plant, Detroit, Mich., United Aircraft Corp., E. Hartford, Conn., New York City Omnibus Corp., N. Y. C., and many others.

In installations like these, each heating problem called for a distinct, individualized application. WING engineers—equipped with years of experience and research in heat distribution, and backed by the pioneer developer of "Floodlight Heating"—can prescribe an installation to solve your heating problem.

WING Heater Bulletin H-8 contains installation diagrams, piping details, and other interesting data. May we send a copy?

L. J. WING MFG. CO.

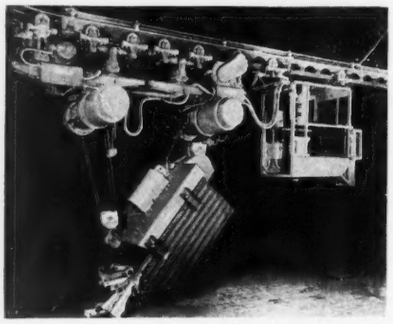
162 West 14th St. **New York, N. Y.**

WING REVOLVING DISCHARGE UNIT HEATERS

They are 12 in. wide outside and come in 2-ft. lengths for 20-watt lamps, and 4-ft. lengths for 40-watt lamps. End baffles attach over joint where two reflectors join forming a continuous trough. Extreme ends are then enclosed by steel end-plates. Wireways come in three lengths: 2 ft. for attaching one 24-in. reflector, 4 ft. for one 48-in. reflector, and 8 ft. for two 48-in. reflectors. Knockouts for ½ and ¾-in. conduit attachment in sides. The Miller Co., Meriden, Conn.

Tilting Box Grab and Carrier

Consists of a cab-operated motor-driven carrier and motorized grab that picks up boxes, sets them down, empties them by tilting; two independent hoisting units that raise or lower boxes, quickly or slowly as desired. Boxes used are provided with



four suspension brackets—two on each side. They make it possible to interlock boxes and stack in tiers. Motor-driven sliding latch bars in the grab may be extended into or retracted from the suspension brackets by the operator in the cab. At 30 or 40 ft. below the carrier boxes can be picked up or spotted in place. Available up to 5 tons capacity, travels on arch beam rails at 300 ft. per min., it is said The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

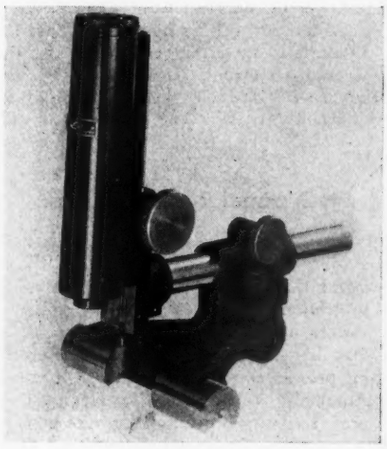
Ammonia Mask

Incorporates an "all-vision" facepiece as standard equipment. The facepiece has enlarged lens area with complete vision through all viewing angles, it is said. Lenses are of laminated shatterproof glass contoured at sides to fit the face. Features built-in reflectors that keep lenses clear of condensation and reduce dead air space to cut down stale air. Mask consists of facepiece, ammonia canister, flexible tube connecting the two, light harness strapping canister to worker, all-rubber headstraps. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh.

Optical Thread Tool Gage

Gage to facilitate set-up of single-point threading tools and for checking tool and thread angles can be set perpendicular to the lathe center axis within two min. of arc, it is said. Consists of a microscope with an eyepiece field of ⅞ in. in which appear the characteristic angles of American National Standard, Whitworth, and

Metric threads. The microscope has rack and pinion focusing, is mounted on a keyed cross-rod which slides for adjustment in a reamed hole perpendicular to a mandrel in the base. To check thread angles the gage is placed on top of the work and the cross-rod of the instrument slid out until the threads appear in the field of the microscope. Accuracy is said to be greatest for small leads. A "V" is ground in the bottom of the mandrel to facilitate setting it on the work. Suitable for work from ⅜ to 6½ in. diameter. Magnification is about 12 times. The Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago.



New Company

U. S. Electric Welder Corporation, 1224 West Bancroft St., Toledo, Ohio, is a newly incorporated company which has acquired the business of the USL Electric Welder Division of the Electric Auto-lite Company.

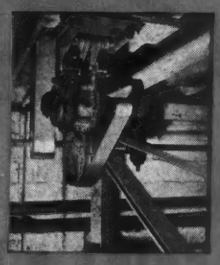
Metal-Cutting Saws

Lines of power metal-cutting saws, identifiable as the "Curled Chip System of Metal Cutting," includes saws to cut any commercially machineable material, it is said. Main feature is a tooth, formed with an inward curved cutting edge, that produces a curled clock-spring-like chip in cutting. The cutting edge bites into the material at a slight angle lifting the chip and rolling it within the curved contour of the gullet. When the tooth reaches the end of the kerf the chip springs free such that no broken chips are carried through a second time. Other features include a large-size gullet and a "buttressed" tooth construction. E. C. Atkins & Co., 402 South Illinois St., Indianapolis.

Snapswitch

Snap-acting non-magnetic switch measuring 2x1x¾ in. has an electrical rating of 1 hp., 110 volts, a.c., and 1½ hp., 220 volts, a.c. Universal mounting permits installation in any position. Incorporation of a single-pole double-throw switch with three built-in terminals makes it possible to "make" and "break" a 2-wire circuit, to "break" one circuit and "make" another

★ 60% Increase in Production with TANNATE-Rockwood Drives



On a cinder block tamping machine, TANNATE-Rockwood drive replaced a long center rubber belt drive . . . stepped up production by 60% . . . paid for itself within the first three months!

★ Stepped-up Production by 10%

On a pulverizing machine in a whiting works capacity jumped ten percent when a TANNATE-Rockwood drive was installed.

★ Increased Production 33⅓% Lowered Cost per Cord Chipped!

Eleven year record on a paper mill chipper. The unusual power transmitting capacity of TANNATE made possible drive changes that increased production one third, decreased cost of production at the same time. User profited doubly.

Tamping machine . . . Chipper . . . Pulverizer drive . . .

★ALL THESE ARE UNUSUALLY HARD DRIVES

but TANNATE'S record is a consistent story of years of dependable service. You too may find a powerful production stimulus and lowered cost through the use of TANNATE. It has wonderful grip, slight stretch and great durability.

Write for your copy of the SHORT CENTER DRIVE DATA BOOK. No obligation.

STEP UP PRODUCTION WITH

RHOADS

Founded 1702

Tannate

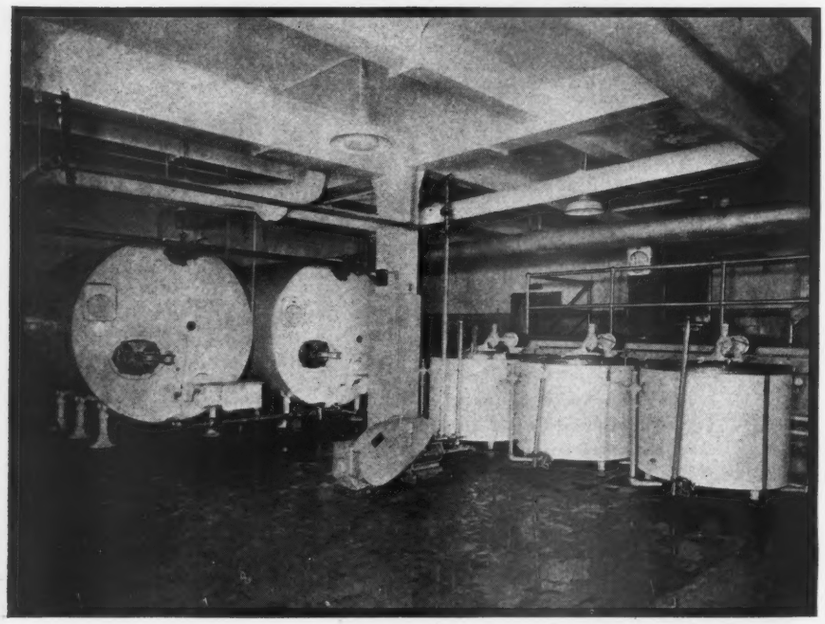
WATERSHED LEATHER BELTING

J. E. RHOADS & SONS · 35 N. SIXTH ST., PHILA., PA.

NEW YORK · CHICAGO · ATLANTA · CLEVELAND

For DAMP Walls Like These

PERMITE *Ready-Mixed*
ALUMINUM PAINT NO. 1600
Is Recommended!



YOU say YOUR factory has no damp walls, doesn't need a wet surface aluminum paint? . . . But you do need a *high heat-resisting* aluminum paint for your boiler rooms. And a lustrous, light-reflecting type for your interior walls and ceilings.

Right! You prove our point again! Most plants need *different* aluminum paints for *different* types of application. No one aluminum paint can correctly fill every need.

And for that reason Permite paint specialists, working in the world's only *exclusive aluminum paint plant*, developed *14 different types* of Permite Aluminum Paint. Each is *ready-mixed* to save time, save waste. Permite Ready-Mixed Aluminum Paints never harden in the can. Leftovers can be used next day, next year. A complete, illustrated, descriptive booklet may be had by executive readers of this magazine. Write today.

ALUMINUM INDUSTRIES, Inc. - Cincinnati, Ohio
Distributors in Principal Cities

PERMITE *Ready-Mixed*
ALUMINUM PAINTS

when two circuits with a common wire are used. In either, direct or reverse action may be obtained by reversing the two outside terminals. Three types: "Push-in" self-restoring actuator; "pull-out" self-restoring actuator; "push-in," "pull-out" non-self-restoring actuator. Minneapolis-Honeywell Regulator Co., 2950 Fourth Ave. South, Minneapolis.

Air Grinders

No. 255 is built on the air-behind-the-blades principle which keeps the rotor blades of the grinder out against the cylinder wall thus preventing "dead center" position or depression of the blades in slots due to oil accumulation. Starting under all operating conditions is thus assured, it is said. Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago.

Manual Motor Starters

Line of across-the-line manual motor starters includes sizes "0" and "1" and is for the starting, stopping, and overload protection of single-phase and polyphase motors up to 7½ horsepower. The starters may be applied on grinders, lathes, printing presses, washing machines, drill presses. Automatic relatching mechanism eliminates resetting operation as there is no intermediate or "tripped" position of the starter handle. Excessive overload will

open the circuit though handle is held in "on" position, it is said. Contacts are silver, metal parts are treated to prevent corrosion. Cover may be padlocked leaving starter free to operate or it may be padlocked in "off" position. Colts Patent Fire Arms Mfg. Co., Electrical Division, Hartford, Conn.

Air-Actuated Proportioner

Designed especially for accurately feeding sulphuric acid in conditioning boiler feed water. Other uses include proportioning of any corrosive solution to the rate of flow of another fluid. Contact meter in series with a cycle controller operates an air compressor inside the proportioner

WHO IS SIMON DEGREE?

. . . he's the guy that blockades production

STOP HIM WITH MODINES

Beware of Simon Degree! He sneaks through factories, lurks in laboratories, hides in offices.

When you find him, his dirty work is done. Workers have slowed up! Production has bogged down! Morale is low! Costs are high!

And it's all the fault of Simon Degree. He's the sinister symbol of insufficient and inefficient heating—the silent saboteur of production and profits.

What About Your Plant ?

So insidious is Simon Degree that he may be in your plant this very moment. Just when Uncle Sam expects you to step-up production as a part of our national defense.

Why risk the losses due to ineffective heating? Kick Simon Degree out *now!* And don't *ever* let him in that new plant or addition.

Take the precaution that thousands of other plants rely on—Modine Unit Heaters—America's *recognized standard.* This is no time to experiment or skimp. Get *proved productive heating* backed by Modines' billion hours of satisfactory service.

Prompt Delivery

New construction, or modernization, calls for 24-hr.-day speed. Modine leadership, Modine facilities . . . Modine organization, alert and ready . . . *guarantee* prompt delivery.

Faster Installation

With *Modine-patented* direct-from-branch-supply-pipe suspension, installation is faster and easier. No brackets, rods or straps . . . every Modine costs you $3 to $8 *less* to install.

More Modines are sold than any other unit heater. Ask your engineers . . . get Modine literature *now!*

Modine representative's name is in your phone book . . . "Where to Buy It" section under Heating Apparatus.

WRITE FOR LITERATURE

modine

THE UNIT HEATER WITH THE BUILT-IN SAFETY FAN GUARD

MODINE MANUFACTURING COMPANY, 1730 RACINE ST., RACINE, WIS.

The Spencer Portable shown at the bottom of the page cleans this large foundry.

In circle: Cleaning above the cranes in foundry.

In square: Picking up oily sawdust in a machine shop.

Below: Spencer Portable Vacuum Cleaning Systems are made in sizes from ¾ to 7½ HP.

ARE DIRT AND REFUSE EATING UP PROFITS *in your plant?*

Every plant has a dirt problem. The cost of removal is as much as 5% of the finished product in some plants. Furthermore, health and insurance regulations in most states now require thorough and regular cleaning.

Fortunately for industry, there is a method of removing dirt that is not only thorough, but that pays for itself, because it is cheaper than cleaning by hand methods.

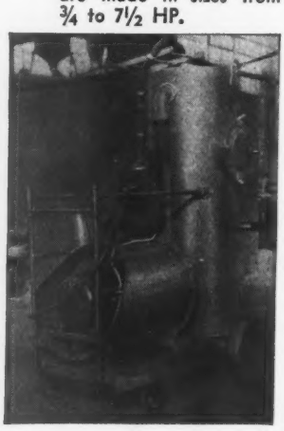
SPENCER VACUUM CLEANING is the fast efficient method that has been making rapid strides in industry during the past ten years.

It Cleans	It Reclaims	It Removes
FLOORS	CHEMICALS	GRIT
LEDGES	FUEL	LINT
MACHINERY	METALS	PAPER
PIPES	RUBBER	POWDER
WALLS	SAND	VERMIN

It is powerful enough to remove tons of sand, yet exacting enough for a watch factory, and is made in a range of sizes from ¾ to 100 HP that makes it economical for any size plant.

If your plant generates bulky litter, the new 7½ HP, 7½ cu. ft. dirt capacity portable will be of interest to you.

Ask for Bulletins No. 102C and 120F.



SPENCER HARTFORD CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS

THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

182-C

shell when a predetermined flow is reached. The acid is measured into the dilution tank to which dilution water is proportioned by a mechanism that prevents abnormal chemical concentration either too high or too low. Special feedline fitting provides for proper introduction of diluted acid or other fluid into main flow. Timer may be mounted directly on equipment or in meter case when an orifice meter is used. Motor-driven air compressor is housed within the cylindrical base which supports the acid tanks. Cochrane Corp., 17th & Allegheny Ave., Philadelphia.

Hand Lift Truck

The Transliftor featuring a mechanical selective (pump action) lift and a lower flush-welded grip with no projecting edges is available in capacities from 3,500-5,000

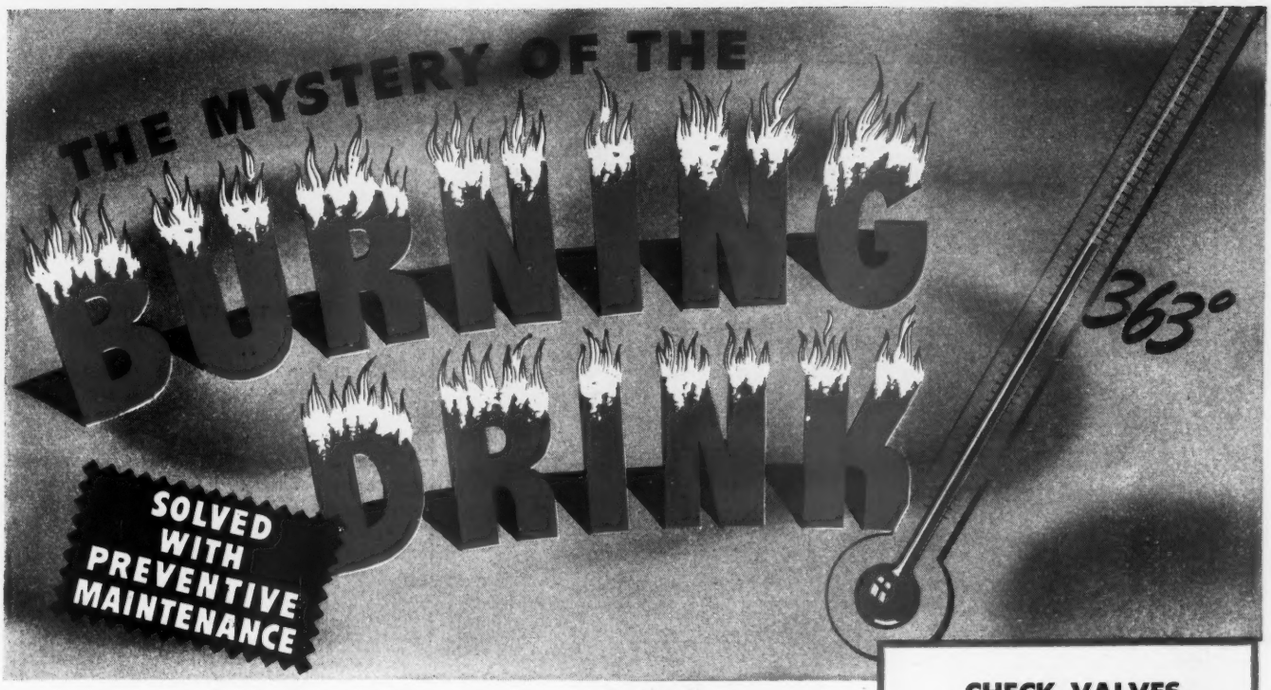
lb., wide or narrow-frame models. Hydraulic release checks prevent dropped loads, torsion-type rear links take care of side sway. Designed for use with skid platforms, the truck lends itself to carrying all kinds of heavy items. The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia.

Welding Tee

Seamless steel welding tees feature construction that places extra thicknesses of metal at points of stress—at intersection of the outlet with the run of the tee. The thickness of the crotch—along the top centerline of the tee—is gradually tapered off to average thickness at the bottom where stresses approach normal. Longer outlets are provided for ease in lining up and welding. Tube-Turns, Inc., 236 East Broadway, Louisville, Ky.

Temperature Control System

Modulating Weatherstat Zone Control System employs a T14A Weatherstat as its master controller. Mounted outside the building on the outer wall of the zone it is to control the Weatherstat has its own thermostat and heating plant adjustable for reflection of heat losses in relation to outside conditions to the same degree as the zone it is controlling. Heat input is determined in relation to heat losses due to outside temperature, wind direction,



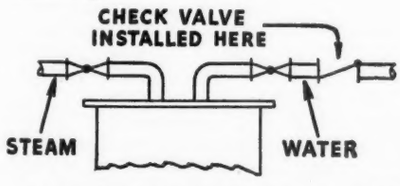
"Accidents like this can cost us a fortune," excitedly shouted the PLANT SUPERINTENDENT.

"How in blazes did steam get into that drinking fountain," woefully spoke the MAINTENANCE FOREMAN.

"But it won't happen again," assured the CRANE MAN. "Preventive Maintenance will see to that."

IN a midwestern manufacturing plant one day, a worker went for a drink. But, as he stooped over the fountain, instead of refreshing water, there came a blast of burning, blinding steam.

In another department, silicate of soda used for processing was melted in a large vat with a steam coil. The liquid was then cooled by running water through the same coil. A globe valve in each line controlled the water and steam to the coil. The water connection came direct from a 2½-inch main line which supplied the entire building.



A batch of the processing material had been melted and was ready for cooling. The water valve was opened wide. But, the operator forgot to close the steam valve. The 160-pound steam easily forced its way into the water line.

And, it was the thirsty worker who provided an outlet for the angry vapor.

"This must never happen again!" said the Superintendent. A warning to the vat handlers wasn't enough. So he called in W. F. C., the Crane Man, who suggested Preventive Maintenance. The solution to the problem was simple, yet Preventive Maintenance would safely guard against recurrence. It counseled the installation of a Crane No. 74E Brass Check Valve in the water line to the processing vat.

Results: (1) the trouble was permanently remedied. (2) The management has peace of mind about the safety of its employees from this danger. (3) Another manufacturer has learned the sound economy of Preventive Maintenance. Has learned, too, to look to Crane for the valves and fittings for the most economical solution to every piping problem. And, he knows it pays to consult the Crane Representative—always.

This case is based on an actual experience of a Crane Representative in our Kansas City Branch.

CHECK VALVES ARE "TRAFFIC COPS" IN PIPE LINES

In industry there are few piping systems, if any, in which backflow is not dangerous or damaging. Thus check valves are often the most essential valves in a line. They police your piping—keep flow going in the right direction.

Systems lacking adequate backflow control afford the Plant Engineer a valuable opportunity to apply Preventive Maintenance now—before costly damage results to product or equipment, or harm to personnel. To meet the varying operating conditions of industrial piping, Crane makes check valves in a complete range of designs and materials—for all working pressures.

You'll get a lot of satisfaction in Crane No. 74E Brass Check Valves. They're rated at 300 pounds steam, 550°, and are built to give superior service. For steam, water, oil or gas lines, they're an outstanding buy. Consult your Crane Representative.

CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO
VALVES • FITTINGS • PIPE
PLUMBNG • HEATING • PUMPS

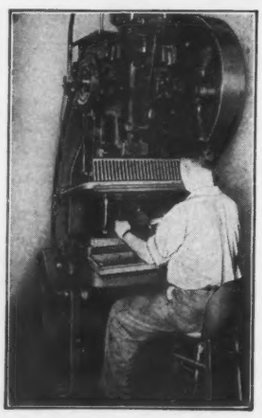
NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

● This is a percentage scale, Toledo-developed to solve a specific problem in curing hams.

You don't cure hams? No—but you probably use percentages in your own production. If so, the *basic principle* of this ham scale may help solve some of your problems, too.

Industry looks to Toledo for the solution of its tough weighing problems. And for greater accuracy and speed in its regular industrial weighing. This percentage scale is a symbol of Toledo's superior engineering knowledge and versatility. It's one of "45,000 Ways to Weigh"—and that's the title of a new illustrated brochure that you will find interesting and helpful. Send for it.
Toledo Scale Company, Industrial Scale Division, Toledo, Ohio.

TOLEDO SCALES



JUNKIN SAFETY GUARDS

- **Prevent Needless Accidents**
- **Improve Efficiency**
- **Increase Production in your plant**

The exclusive Triple Interlock feature of Junkin Guards rules out human error and carelessness from your press operations. A non-repeat principle limits the press to a single stroke on hand-in-the-die operations. Thus operators' hands are always *safe*—efficiency picks up—production flows faster. . . . Write for complete facts and the name of your nearest distributor.

Send for Free Copy of "Stamping Presses—Their Safety, Uses and Abuses"

JUNKIN SAFETY APPLIANCE COMPANY, Inc.
934 W. Hill St., Louisville, Ky.

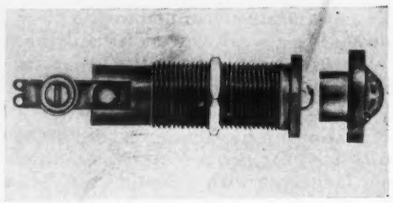
wind velocity, solar radiation. Designed to control single or multiple zone jobs with each zone having a separate control panel, the control is applicable to two-pipe steam-heating systems only. Recommended for installations where a constant source of steam is available and where a motorized steam valve can be installed. Minneapolis-Honeywell Regulator Co., 2950 Fourth Ave. South, Minneapolis.

Deaerating Heater

Trayless deaerating heater removes oxygen and free CO_2 from the water. It requires no trays for deaeration but sprays the water from non-corrodible spray valves through steam which heats the water within 3 or 4 deg. of steam temperature. Preheated water then passes through the steam scrubber from which last bit of oxygen and free CO_2 are removed. May be used in conjunction with hot lime soda softeners, zeolite softeners, Zeo-Karb H and Na, or Zeo-Karb Na plus sulfuric acid treatment and is adapted to all requirements for heating and deaerating boiler feed water. The Permutit Co., 330 West 42d St., New York.

Indicating Lamp and Annunciator Unit

Molded-plastic unit for use in indicating lamp service, panelboards, switchboards, annunciators features small lens diameter, is constructed to allow a full 180 degrees



of light over the lens cap, incorporates an "anti-false" color feature—a plastic shell and lens cap of the same color—to prevent insertion of a wrong lens cap into the unit (of value on switchboards). Electrical parts consist of two spring-tempered contact terminal strips which contact the lamp bulb and provide incoming wire terminal connection. Units up to 48 volts use no resistor assembly. On 120, 220, 440-volt units a resistor is incorporated. Supervision of lamp filament is accomplished with a "split" resistor which allows a dull glow at all times—available on 120 and 220 volts. H. R. Kirkland Co., Morristown, N. J.

Vacuum Cleaner

"Silent" vacuum cleaner for heavy-duty work and all-purpose cleaning has eliminated fan and motor hum so that it can be used in offices, waiting rooms, salesrooms without distracting occupants. One-hp. motor is directly connected to a series of three fans. Dirt and dust are trapped in a 7½-gal. tank. Portable, the unit weighs 60 lbs. and is mounted on rubber casters.

Now Available—
"3C" Bulletin 100, Heavy Duty Push Buttons in Dust Tight and Water Tight Cases
START
STOP
DUST TIGHT IN ACCORDANCE WITH NEMA DEFINITION IC 50-28
WATER TIGHT IN ACCORDANCE WITH NEMA DEFINITION IC 50-43
1, 2, 3, and 4 UNIT STATIONS AVAILABLE!

● Inside this sturdy, weatherproof, cast aluminum case you'll find the same husky mechanism used in all "3C" Type "D" Heavy Duty Push Buttons. Silver-to-Silver Button Type Double Break Contacts • • • All insulating parts Bakelite • • • large electrical and mechanical clearances • • • Push Button travel not limited by contacts • • • all parts removable and replaceable with a screwdriver • • • All these are features of Type "D" Heavy Duty Push Buttons.

● And what an enclosure! Cast aluminum with evenly machined surfaces between cover and base • • • exterior operating mechanism and stuffing box mounted in the cover • • • small nut on operating shaft for adjustment of stuffing box • • • drive screws hold gasket firmly to cover • • • gasket can't buckle • • • can't come loose, can't get lost • • • gasket holes always in perfect alignment with holes in cover and base. Pilot lights with color caps for interchangeable mounting with units are available.

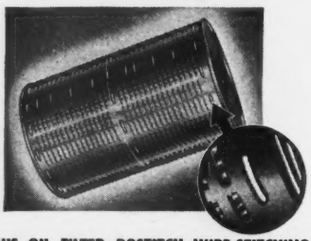
WRITE FOR FOLDER GIVING COMPLETE DETAILS

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

If you're engaged, directly or indirectly, in manufacturing for defense, you should know about *faster fastening* with Bostitch machines—for metal, wood, cloth, paper. Bostitch stapling, stitching and tacking have replaced countless other fastening methods—providing *securer*, often *much* cheaper assemblies, as well as saving valuable time.



ON THIS OIL FILTER, BOSTITCH WIRE STITCHING IS FASTER THAN RIVETS, BETTER THAN WELDS

A single operation of the Bostitch Steel Stitcher feeds stitch, punches hole and clinches staple. No distorted metal. Result: oil filters assembled faster, better.

FOR SHIPPING ROOM OR PRODUCTION LINE

Two extremes in Bostitch fastening machines: the Self-Feeding Hammer, the high-production Steel Stitcher.

18 Research Engineers . . . 782 easy-to-operate models . . . 300 specializing representatives . . . to help you adapt the Bostitch principle to your fastening problem. Send samples for free recommendation.

BOSTITCH: AN AID IN THE RACE AGAINST TIME

The experiences of thousands of manufacturers suggest that *you* can shorten delivery dates—by fastening with Bostitch instead of tacks, nails, tape, glue, clips, welding, rivets and screws. Send today for "Bostitch Fastens It Better with Wire," describing liberal trade-in, budget and rental plans.

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STAPLING • STITCHING • TACKING

Bostitch, 60 Division St., East Greenwich, R. I.
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Send free copy of Folder, "Bostitch Fastens It Better with Wire," containing fastening facts for my industry.

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Company .....

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.....

My industry 9-40

Equipped with 10-ft. rubber-covered hose, double-curved steel extension tubing, swivel floor and carpet nozzle, furniture nozzle with detachable brush, and flat fiber crevice tool. Operates on 110 volts, 50-60 cycles. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore, Ill.

Ratchet Threader

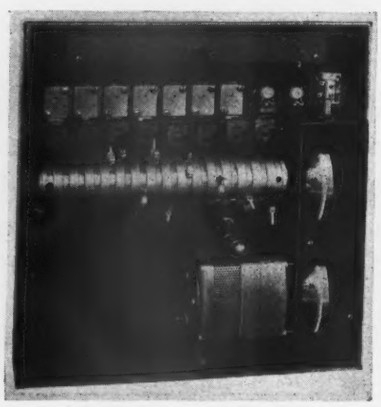
Simpact, one to two-in. self-contained ratchet pipe threader, has a handle 24 in. long and weighs 20¼ pounds. Features claimed: Automatic drip oiling, high-speed steel dies used to cut tapered threads, die size changed by pushing size-selector buttons and shipping dies into proper steps, deep-throated dies backed with tapered threads may be resharpened when necessary. The threader is equipped with a 3-jaw rear gripping device consisting of three broadfaced chuck jaws, graduated guide posts, winghead thumb screws for centering the tool on the pipe. The Toledo Pipe Theading Machine Co., Toledo, Ohio.

Dust Collector

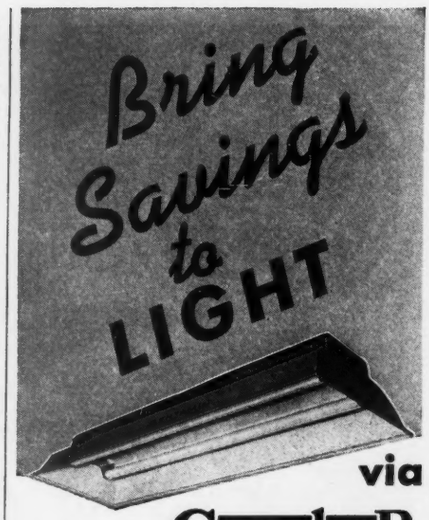
Small assembled-type Dustube dust collector is equipped with a hand-operated shaker and a bin hopper and is recommended for use in handling small volumes of air—270-1,440 cu.ft. per minute. It is suited for collection of dusts created by sand blasting, tumbling, Wheelabrating, grinding, and for trapping dust having a recovery value. Hopper stores the dusts and acts as a base for the entire unit. The American Foundry Equipment Co., 579 South Byrkit St., Mishawaka, Ind.

Time-Cycle Controllers

Flex-O-Timer adaptable for all-electric operations, all-pneumatic operations, or combinations of both obtains flexibility through use of adjustable pins on the revolving drum, eliminates cam cutting, offers a varying drum-speed rotation—78 drum speeds with each gear-train ratio. The



actuating pins are adjusted in circumferential undercut grooves on the one-piece drum and locked in place with a screw. Latch-trip solenoid-operated mechanism starts the timer motor and any outside electrical or pneumatic functions to be



via

GraybaR

with the Benjamin "Stream-Liter"

For sight-saving, money-saving lighting throughout the plant, get the story from GRAYBAR on this new fluorescent lighting unit. The "Stream-Liter" is now available in both two and three lamp combinations — utilizing 48-inch, 40-watt fluorescent lamps in a high-efficiency porcelain enamel reflector. It's cool in operation, easy to keep clean, ideal for shadowless lighting for peak "night-shift" efficiency.

Benjamin "Flur-O-Liter"

Specifically designed for "high level" localized lighting, the new Benjamin "Flur-O-Liter" is just right for close machine work, inspection and other critical seeing tasks. Each "Flur-O-Liter" unit consists of two individual semi-concentrating reflectors of polished Alzak aluminum, mounted and supported in a single housing — available in sizes for either two 48-inch, 40-watt or 36-inch, 30-watt fluorescent lamps.

A GRAYBAR lighting specialist will gladly give you all the details, prices on these and other fluorescent lamp units and accessories whatever your needs. Write Dept. F, Graybar Electric Company, Graybar Building, New York.

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HEADQUARTERS for FLUORESCENT LAMPS—ACCESSORIES—REFLECTORS

GraybaR QUALITY Since 1869 *Everything Electrical* GraybaR ELECTRIC COMPANY

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Shafer Roller Bearings are ideally adapted to the great majority of industrial bearing needs, for the exclusive concave roller design combines: 1. Self-alignment within the bearing itself; 2. Capacity for radial, thrust, or combined radial-thrust loads; 3. Simple adjustability.

Misalignment, shock, or shaft deflection will not affect the free-rolling bearing action, long life and reliable performance of this bearing. Shafer stock mounted bearing units are compact and substantially built, available in a full range of types and sizes for all power transmission uses. Write for Catalog No. 15 with full details of the complete line. Shafer engineers will gladly assist you in selection of the right bearings for your individual needs.

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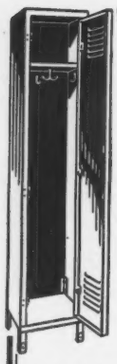
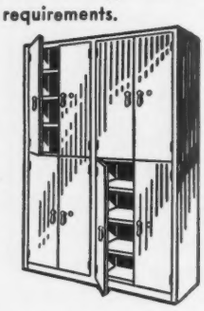


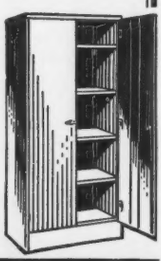
Profit *All Ways* with PENCO PRODUCTS

Penco Heavy Gauge Steel Lockers are synonymous with that extra quality and workmanship which means the utmost in space savings, reduced fire hazards and improved employee morale. Consult with PENCO engineers for the type of locker, cabinet or shelving best adapted to your requirements.

PENCO Steel Shelving makes it easy to keep stock and tools in their proper places, steps up production and increases the efficiency of material and tool control departments.



PENCO Steel Cabinets are designed in numerous sizes of storage and wardrobe combinations for the safe storage of personal apparel and materials. Widely acclaimed as satisfactory from every viewpoint.



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PENCO products are Steel Shelving, Cabinets, Lockers, Small Parts Bins, Tote Boxes, Shop Benches, Shelving Trucks, Steel Counters and Tables, Corrugated Metal Culvert Pipe and Metal Specialties.

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EASY UP, EASY DOWN AND ALWAYS TIGHT
It's easy to seal a pipe joint—and just as easy to seal it air-tight and liquid-tight so that it will come apart easily six months or six years hence if the job is done with Dixon's Pipe Joint Graphite Compound—"the sealing lubricant."
Like natural flake graphite from which it is made, Dixon's Pipe Joint Compound is impervious to heat, pressure, and all solvents. Again like graphite, it never loses its slippery unctuousness.
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GRAPHITE EXCELLENCE SINCE 1827

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JERSEY CITY, NEW JERSEY

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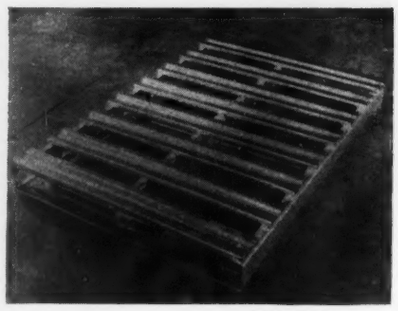
performed simultaneously at the start of the cycle. (External pushbutton or limit switch can be used to start the process.) Low leak air valve is said to utilize 99½ per cent of the air passed through it. Air valve plunger is designed so that the air supply port cannot at any time communicate with the exhaust port, it is said. High-capacity air valves simplify piping. Taylor Instrument Companies, Rochester, N. Y.

Fork Truck Pallet

Sectional-face all-steel pallet, for use with hand fork trucks for short movements of pallets, is made of 6-in. wide channels with heavy corrugated center ribs. Opening between sections is said to be of sufficient width on the bottom face to allow small roller wheels on the truck to touch the floor. For this use these sections may be filled with wood to provide a smooth even surface for the wheels to roll over as they load and unload the pallets. Lighter weight facilitates use in shipping. Built in various sizes to handle most any kind of load. Palmer Shile Co., 7100 West Jefferson Ave., Detroit.



Portable A.C. Welder

All-purpose Flex-Arc welder operates on 220 or 440 volts; is self-contained, being enclosed in a steel case mounted on three wheels; and is furnished with all accessories including welding helmet with lens, electrode holder, leads, 17-lb. assortment of electrodes, three-pronged plug and receptacle for the power lead. From 20-250 amp. of welding current is available in twenty-seven current steps with increments proportioned for a wide variety of elec-

IT'S HERE AT LAST! A DURABLE CONCRETE PAINT

WONDERFUL NEW INGREDIENT MAKES PAINT DEFY CHEMICAL ACTION THAT DETERIORATES OTHER PAINTS ON ALKALINE SURFACES

FORGET your past experience in painting concrete, stucco, plaster, cement asbestos materials, and other alkaline surfaces. This new paint really stands up. But that's not all. You can actually apply it to green concrete. That means you start operating new plants quicker. It dries rapidly. That means you can paint between shifts in plants that are operating, without losing working time.

Parlon-base paint gives a hard, tough, flexible film that is remarkably resistant to abrasion and wear. It seals against moisture that causes concrete to crack and chip. It prevents dusting. A wide range of colors makes it highly decorative. Best of all, it reduces maintenance costs.

WHERE TO BUY PARLON-BASE PAINT

Leading paint manufacturers make Parlon-base concrete paints. You can probably buy them from your regular supplier. If not, tell us the name of your supplier and we will be glad to help you. Mail the coupon for complete information about the paint that really protects and beautifies alkaline surfaces.

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Tightening up

Impetus of rearmament programs presses on to take up the slack in production, and where do you find the "slack" so recurrent as in equipment tie-ups, down-time of machines, lost time of mechanics and operators?

The tightening up of loose operating practices implies tightening up of machine assemblies and adjustments of all kinds — specifically by use of Hollow Screws that HOLD above all others!

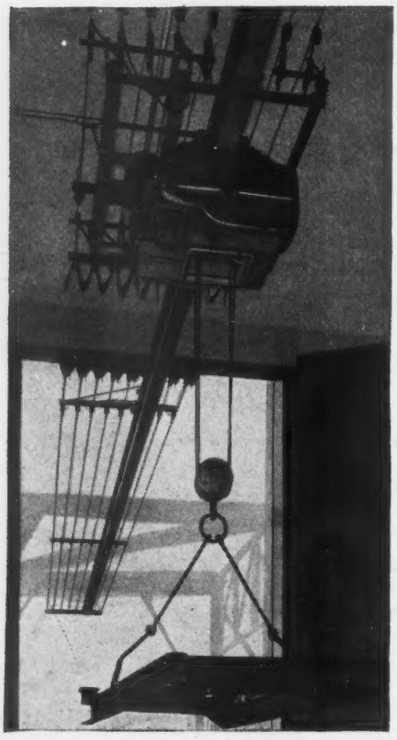
It's hardly needful to *name* the screws, in view of the fact that the *same* make of screws has held the Quality market for 30 years, — some of which decidedly were years of "tightening up".

Cold-drawn, "pressur-formd", scientifically heat-treated, precision-threaded, — ALLEN hollow set and cap screws are steeled to the new schedules and specified with the new incentive of PREPAREDNESS.

Your local Allen Distributor will oblige with samples and SERVICE.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONNECTICUT, U.S.A.

A new idea in CONTROLLED MATERIAL-FLOW with R & M LOW HEADROOM HOISTS



From outdoor yard storage to second-floor machine shop in *one* operation . . . controlled by *one* man . . . from *one* point. That's the sort of time-saving, cost-reducing material-flow you can get with the new R & M Low Headroom electric hoist and motor-driven trolley, as illustrated here.

It has a hoisting speed of 20 ft. per min. and trolley travel speed of 100 ft. per min. In this installation every foot of material movement is controlled from a station inside the second-floor door.

This is the R & M answer to one man's problem. Controlled material-flow with R & M Low Headroom Hoists may be your solution, too. Just give us the facts, briefly, and we'll be glad to talk it over with you.

All R & M Electric Hoists are of compact, low-headroom design, giving you 1' 6" to 2' 6" more usable space than would hoists of conventional design.

ROBBINS & MYERS, Inc.
HOIST & CRANE DIVISION • SPRINGFIELD, OHIO

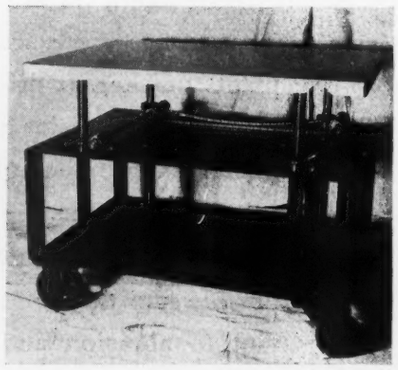
trode types and diameters. Built-in De-Ion breaker insures protection against sustained overload. Open circuit or striking voltage ranges from 80 volts at 20 amp. to 50 volts at highest current rating. Westinghouse Electric & Mfg. Co., Department 7-N-20, East Pittsburgh.

Grounding Wedge

Loxbox grounding wedge used to ground regular bushing or notched locknut on connector for thin-wall conduit consists of a wedge-shaped clamping ear which hooks into a rectangular-shaped slot over knockout in interior of outlet box. (Furnished with slots to accommodate the wedge.) Screw is tightened so that its sharp-pointed extremity bites into the locknut or bushing to insure electrical continuity between box and conduit. Can be used with any ½-in. bushing for rigid conduit or ½-in. locknut on various types of connectors. Appleton Electric Co., 1701-29 Wellington Ave., Chicago.

Feeder Trucks

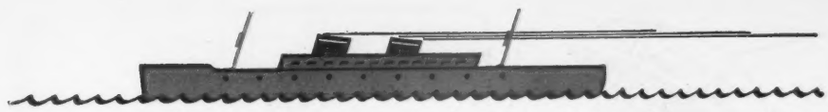
Flat-top die trucks, electric-welded construction, are for use in tool, die, and machine shops, around punch presses for transferring, transporting, and supporting material. Two styles: F-1—table measures 28x40 in. maximum height from floor is 40 in., minimum height is 24 in., safe load



is 3,000 lb.; F-2—table measures 24x32 in., maximum height from floor is 40 in., minimum height is 24 in., safe load is 2,000 pounds. Both have rubber-cushioned ball-bearing heavy-duty casters. O. Johnson Mfg. Co., Dept. B, 6027 West Roosevelt Road, Cicero, Ill.

Volume-Delivery Foot Gun

Model 6697-A, low-pressure type, is recommended particularly for lubrication of trucks with big wheel-bearing and universal-joint capacity and gear boxes on large industrial equipment. Adaptable as an auxiliary to stationary power guns, as standard equipment where a stationary power gun is not required, for field use. Said to have capacity of 25 lb, to pump approximately one cu.in. of grease per stroke, to have maximum pressure of 3,000 lb. when operated by hand for light bear-



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No matter what the final use of the product you make, if it involves metal cutting, Disston *Di-Mol* Hack Saw Blades can play an important part. For *Di-Mol* Blades have the stamina to meet trying feeds and speeds developed in machine sawing; need no coddling in the hands of shop men.

And Disston *High Speed Steel* Hack Saw Blades will cut with greatest efficiency on the newest alloys or metals of extreme hardness.

Take advantage of the many services offered by your distributor of Disston Hack Saw Blades. Henry Disston & Sons, Inc., Philadelphia, U. S. A.

make men and machines more efficient

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Safe, and roomy platforms allow for tools and supplies.
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Ladder jobs, shortened; extra men required to steady ordinary ladders are eliminated. Each piece of material thoroughly tested. Dayton Safety Ladders, made of tested airplane spruce, combine great strength with lightness of weight. Write for catalogue today.

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As Safe as Standing on the Floor

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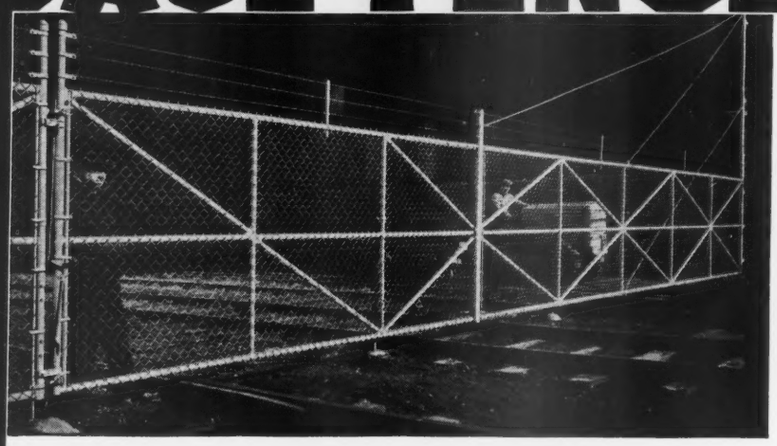

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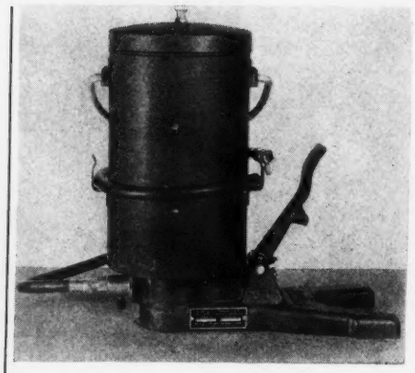


ings, of 5,000 lb, when operated by foot for tighter bearings. It is equipped with a 7-ft. hose, weighs 39 lb., stands 19⅝ in. high, is provided with a squat base for positioning. Alemite Division, Stewart-Warner Corp., 1828 West Diversey Parkway, Chicago.

Odorless Foot Disinfectant

Showersan solution, an aid in prevention of Athlete's Foot and a general disinfectant, features high permeating and penetrating power, a high phenol coefficient that it is said to be able to kill the more resistant Athlete's Foot organisms in one minute, when properly used, without harming healthy skin tissues. A rubber foot-bath tray, two sizes, is available. Solution, 2 oz. to one gallon of water, does not deteriorate on standing. West Disinfecting Co., 42-16 West St., Long Island City, N. Y.

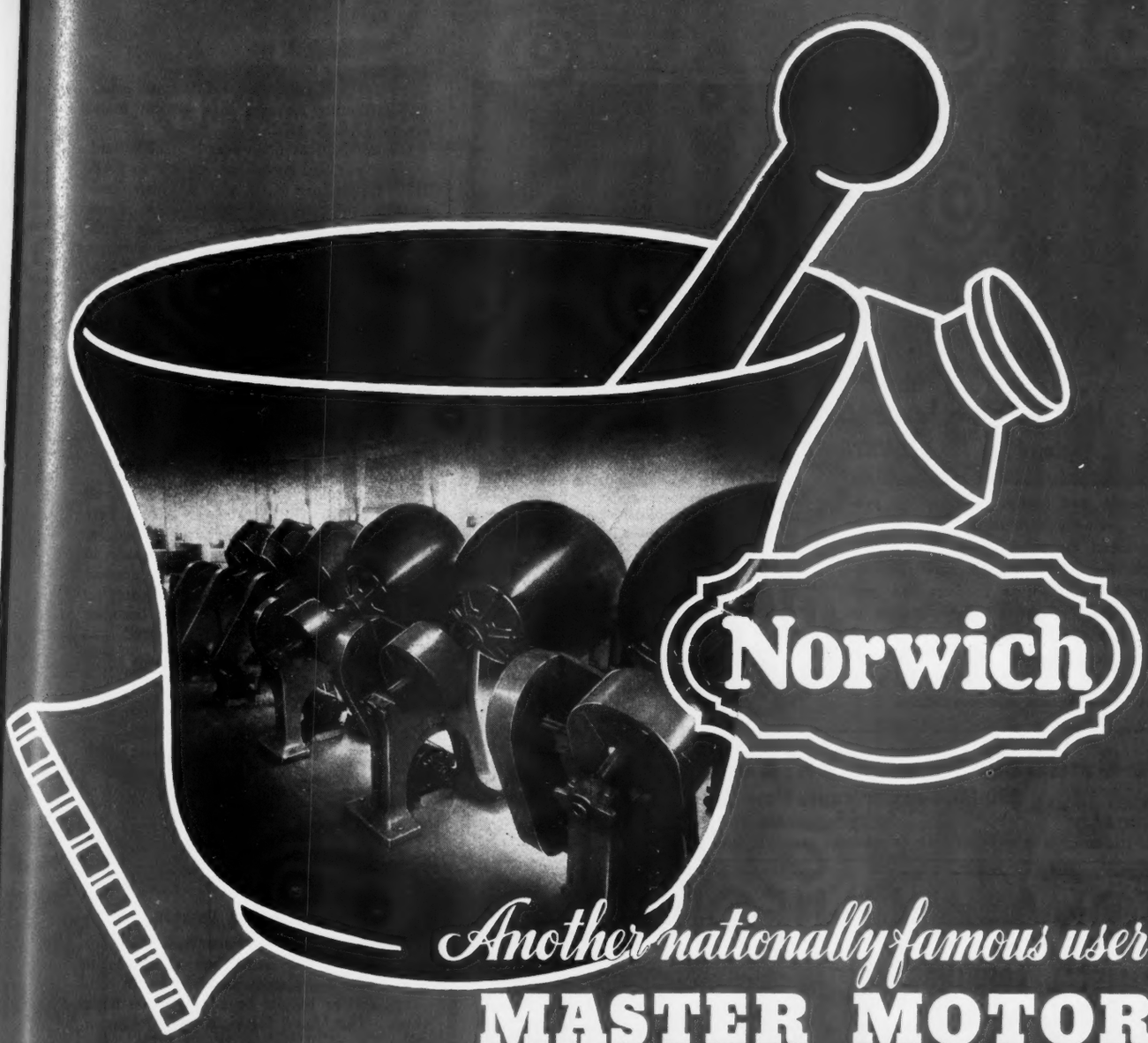
Insulating Steam Joint

"Hose-type" joint consists of a seamless rubber tube compounded to resist steam and heat and covered with plies of closely woven duck. Layers of insulating rubber

are placed between the plies, a heavy gage cover is applied on the outside. Each joint is 8 in. long and built to stand 100 lb. steam pressure. A hose clamp is furnished on each end for attaching to standard size iron pipe. The joints are replaceable and adequate for normal conditions of acid and other chemical handling equipment, it is said. Hanson-Van Winkle-Munning Co., Matawan, N. J.

Screw Steels

Bessemer screw steel, Union Maxcut, is said to have physical properties comparable to SAE X 1112, to produce parts with a smooth fine finish when machined at 280 surface ft. per min. with basic feed of 0.0095 in., and an average tool life over



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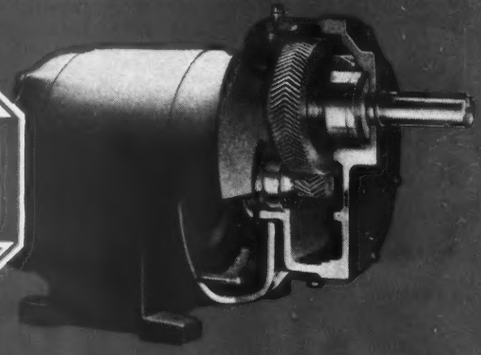

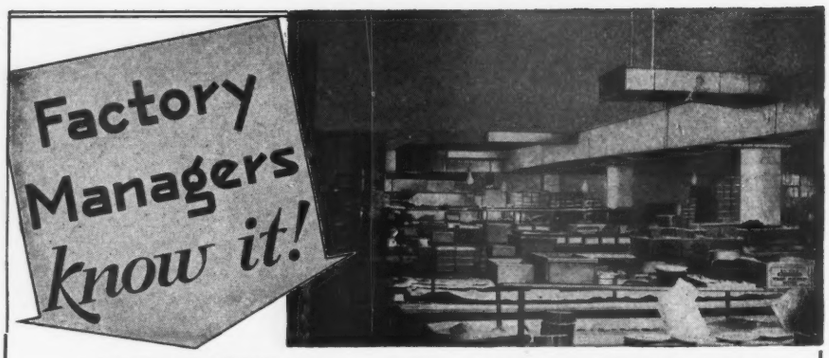

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Industrial plants require more than the methods and equipment used to provide ordinary comfort. There are no packaged air conditioning systems for factories. The system must be designed and built to produce the predetermined condition best adapted to the particular industry, to meet the exact requirements of materials and products. Absolute control and positive performance are essentials.

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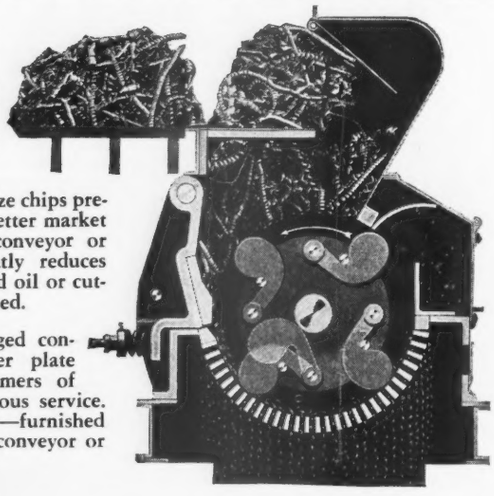
NOW—A UNIFORM SIZE

For METAL TURNINGS

The Jeffrey metal turnings crusher reduces long coils of alloy or steel and brass turnings produced by automatic screw machines and lathes to uniform size.



Has these advantages: uniform size chips preferred by consumer; they bring a better market price; more easily handled—by conveyor or magnet; better for storing; greatly reduces volume—more tonnage per car; and oil or cutting compound more easily reclaimed.

Six sizes—extra heavy and rugged construction—manganese steel breaker plate liners and steel side liners—hammers of 'Flextooth' type—built for continuous service. Patented design of metal catcher—furnished with feed hopper or flap gate for conveyor or hand feed.

Cross-section above shows 'Flextooth' crushing elements and standard size feed hopper. Crusher rotor with 'Flexteeth' may be seen at the left. Teeth maintained in outer or crushing position by centrifugal force.

Our Reduction Division will be glad to go into details

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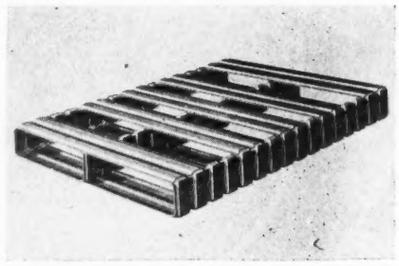
New York, Boston, Buffalo, Philadelphia
Pittsburgh, Scranton, Huntington, Cincinnati, Birmingham
Cleveland, Detroit, Chicago, St. Louis, Houston
Terre Haute, Milwaukee, Salt Lake City, Denver, Baltimore

11 hours, to respond to cyaniding and other case-hardening features in a similar manner to SAE X 1112.

Union Multicut open-hearth steel is said to have physical properties similar to SAE 1115, to produce parts with a finish comparable to Bessemer screw stock when machined at 275 surface ft. per min. with basic feed of 0.0087 in., to have average tool life over 8 hours. (With lighter feeds it can be run up 350 surface ft. per minute.) Can be carburized and hardened to minimum case hardness of C 60 Rockwell with single or double quench, produces tough ductile core in case-hardened parts with minimum of distortion in quenching. Republic Steel Corp., Cleveland.

All-Steel Pallet

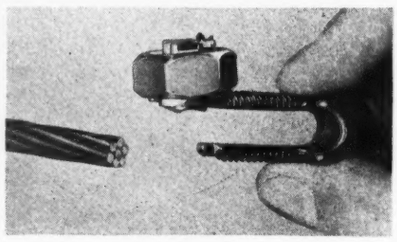
For use with fork lift trucks and hand pallet trucks. Corrugated cross members are welded to channel members shaped for the corrugations. Construction is said to permit use of light-gage steel, to prevent weaving, to provide necessary load-carrying capacity. If a cross member becomes damaged, it can be removed, repaired, and



replaced. Height measures 5¼ in. overall, clearance is 4-in. between deck and bottom, length and width are varied to fit requirements. Can be furnished with solid deck and/or bottom by adding cross members. The Union Metal Mfg. Co., Canton, Ohio.

Nut Retainer

Available for all sizes of the company's Servits from No. 6 solid to No. 4 stranded conductors. The nut retainer holds the nut-pressure bar assembly in any desired position in relation to the U-bolt such that when the connector is being installed on the wire the retainer will hold the nut-pressure bar assembly clear of the slot in the U-bolt permitting installation of



the Servit with one hand. After installation the retainer can be folded out of the way so as not to interfere with taping. Its frictional fit is said to prevent radio interference. Burndy Engineering Co., Inc.,, 459 East 133d St., New York.

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To Get Ahead, They Learn to Talk

(Continued from page 66)

group. Self-help speakers are now receiving an enthusiastic reception from the apprentice audiences. Here they are getting their first experience before an entirely strange audience.

"This class has got to live or die on its own unsponsored merits," says Mr. Baker. "I provide the heat and light and a place to meet in my living room. Beyond that I am simply an observer. However, there are many indications that it will live and keep on expanding. If it does, either we are going to have to move the furniture out or move the class to new quarters."

All Rate the Speakers

The plan of conducting this class is simple. A chairman and secretary are elected to serve for one meeting only. Each speaker is rated by each member of the audience and the ratings are tabulated. The speaker who receives the highest number of points automatically becomes chairman of the next meeting. To the next best speaker falls the position of secretary of the next meeting.

The responsibilities of the chairman are as follows: (1) Select speakers, (2) assign topics, (3) conduct meetings, (4) introduce speakers, (5) keep things moving.

The secretary must: (1) Prepare and issue rating cards, (2) collect and average these cards, (3) notify speakers of the results of their efforts, (4) keep minutes of the previous meetings.

Three Types of Speakers

At each meeting there are two prepared speeches, each with a 20-in. time limit. In addition to the two prepared speeches, there are two notified, but unprepared speakers. Their time limit is ten minutes. Each meeting winds up with four impromptu speakers, each of whom is allotted a five minute time limit.

There is no repetition of principal speakers until all have had an opportunity to speak in this capacity.

Each speaker is rated on the basis of 100 points. The individual's grade for the evening is secured by adding his total number of points and dividing by four. A grade of 100 is, of course, considered perfect, 90 excellent, 80 good, 70 fair, and 60 poor. The qualities rated are as follows:

1. *Coherence—100 points.* This in-

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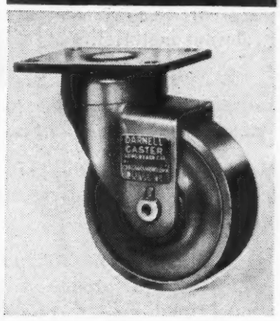

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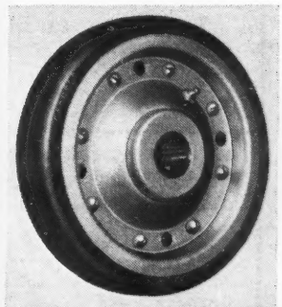

cludes thoroughness of preparation, logical arrangement of points, directness of delivery, and avoidance of irrelevant material.

2. *Poise—100 points.* Includes posture, gestures, facial expressions, ease, courtesy, and smoothness.

3. *Grammar—100 points.* Construction of sentences, correct use of words, and conciseness.

4. *Enunciation—100 points.* Diction, voice control, pronunciation, clarity of tonal quality, and avoidance of repetition.

Conveyors Solve the Problem

(Continued from page 65)

from the top strand of the third-floor conveyor.

Cartons that have not been removed from the top strand by the time they have traveled almost to the end are pushed onto a curved, roller section which discharges them onto the bottom strand. To prevent pile-ups on the bottom strand, when cartons come off the top strand too fast to flow smoothly along, they are forced against a horizontal traffic control lever which is mounted close to the bottom strand. When this lever swings to one side it causes a heavy pin to be pushed up between two rollers in the upper part of the gravity roller section. This pin stops the passage of any more cartons until the jam at the entrance to the bottom strand has been cleared.

All odd-lot (less than carton) orders are filled on the second floor; therefore, a stock of all regular items in all standard sizes of cans is kept here. Individual cans are stacked in bins and on shelves in much the same way that they are displayed in paint and hardware stores. Several men are employed to open cartons coming from the upper floors and keep a sufficient quantity of each item in stock.

Broken-lot orders for local delivery are placed in the cartons whose contents have been put in stock. Then these cartons are placed on the bottom strand of the conveyor and go down the chute to the gravity roller conveyor in the shipping department, along with cartons coming from the other floors.

In the shipping department all cartons are removed from the conveyor and taken immediately to cars or trucks, or stacked temporarily in areas reserved for shipments to various cities and branch offices.

We wanted to simplify and make as easy as possible the work of sorting out and getting the different items in our standard line of products from the carton-sealing operation to the shipping room. The conveyor system and method of handling described in the foregoing have, we feel, accomplished these objectives.

What Belongs in the Methods Study Program

(Continued from page 52)

with the other hand. A hand screwdriver was used, and at the end of each cycle it was dropped on the table, never twice in the same place. This necessitated looking or groping for the tool each time it was used.

Figure 3 illustrates the use of a disposal chute for finished parts on a tubular riveting machine in a plant manufacturing beauty parlor equipment. The operator assembles two small stampings and places them in position on the anvil of the machine. While the rivet is being inserted and set by the machine, the operator assembles the next two pieces. The finished assembly

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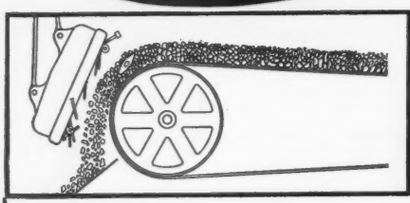

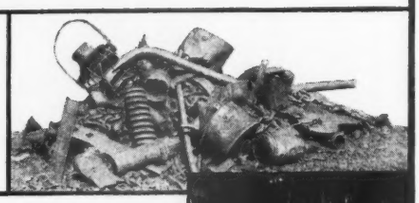

RECLAIMING useable mine hardware (track spikes, car couplings, slate wedges, etc.) from conveyor belts as the coal comes from the mine is but one way in which EC&M Separator Magnets make a *profit* for users.

Yet the greatest saving comes not from value of salvaged material but from elimination of damage to crushing equipment . . . and assurance of a *better finished product.*

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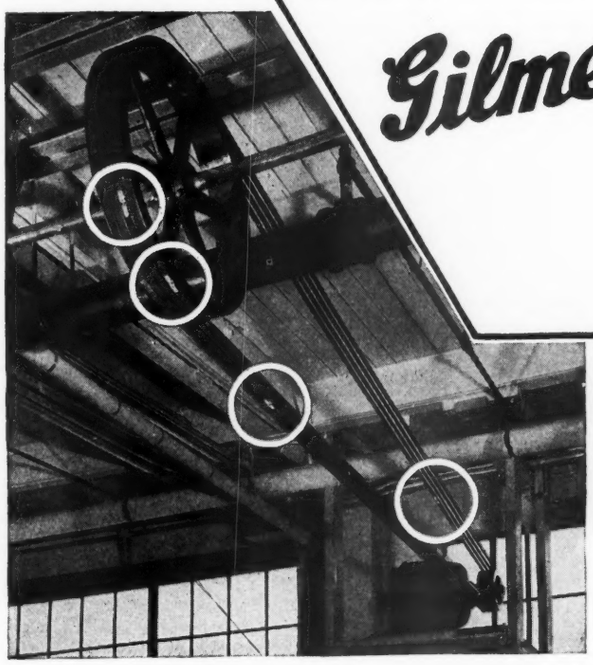

Gilmer Streamliner V-Belting operating to a lineshaft where an obstruction prevents the use of Endless V-Belts. Connectors shown in circles.

The fastener consists of two die-formed steel end-plates, two 2-piece pins, two bushings, links and special nails. Will withstand excessive wear. Rustproof.

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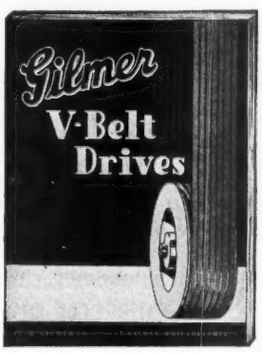

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☐ A copy of your Gilmer Guide to Efficient V-Belt Practise

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is ejected into the chute by the action of the machine.

Formerly the operator held the two parts while they were being riveted, and then reached a distance of over two feet to drop the assembly into a tote box or pail on the floor.

After seeing such illustrations, the group might go to work on a similar problem of arranging a work station for some operation in one of their own departments. This problem should be studied by experimenting with parts bins, tools, and materials brought to the classroom for this purpose. After a satisfactory arrangement has been developed, attention should be turned to pointing out definite principles that can be applied to other operations and work stations.

Perhaps the class problem will bring out the advantage of the semi-circular work place over the straight-line arrangement of parts bins. This can be set down as a principle developed by the group, which can be applied to other jobs. If the solution involves prepositioning the tools or the use of drop delivery chutes, these techniques can be recognized as applicable to other operations.

Deriving principles and general methods through the solution of actual production problems will effectively demonstrate their practicability and will make it much easier for the class members to visualize how they can be applied in other situations. By judicious selection of the examples and problems, and by proper leadership of the discussions, it will be possible to develop through group experience all of the general principles and techniques used in methods improvement.

Another session might be devoted to the proper organization of operations. Solution of a problem similar to the one shown in Figure 4 will bring out the possibilities of cutting down handling by combining two operations. This operation is the assembly of two tin stampings which form the dredge or cover for a spice box. Formerly, two girls pre-assembled the two pieces and handed them to a punch press operator who fed them down a chute into the die that crimped the two parts together. On such a simple operation, this extreme division of labor involved excessive handling. With the new method, the punch press operator assembles the pieces herself, the two parts being supplied from bins on either side of the press. This change increased the production per man-hour 67 percent.

Topics Fit Group Interests

If the group is made up largely of supervisors or operators from a machining department, the meeting topics might include tooling set-ups, cutting feeds and speeds, methods of holding the work, use of indexing jigs and multiple set-ups, handling of parts at the work station, analysis and reduction of idle machine time, and selection of the most economical method for each job.

For a group from a continuous or bulk-processing department, the meetings might be based on such things as the analysis of machine rates and cycle times, determination of optimum batch sizes, analysis of shrinkage loss, studies of the proper crew size for various operating conditions, the systematizing of set-ups and clean-ups, and the possibility of performing part of the clean-up during the operating time.

In one processing department mixing cycles were reduced materially by a systematic study, and in a varnish-cooking plant batch sizes were increased from 3,000 to 5,000 pounds to reduce the time per pound. In studying crew sizes, it is commonly found that too many men are available at certain times, too few at other times. In one plant, a clean-up procedure involving 13 men was reduced from seven hours to around four, largely through the efforts of the supervisors and operators. Such

(Continued on page 154)

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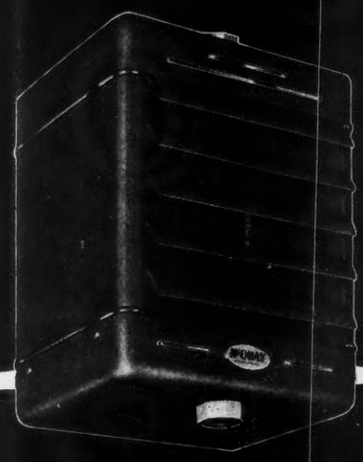
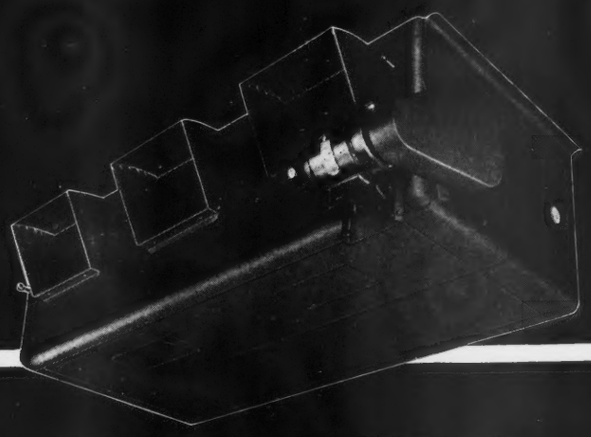
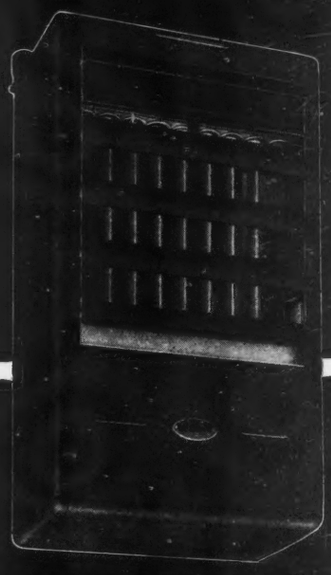


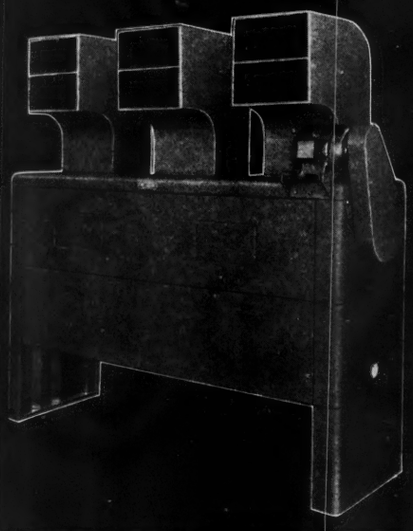
STANDARD UNIT HEATER



BLOWER TYPE UNIT HEATER (*SUSPENDED*)

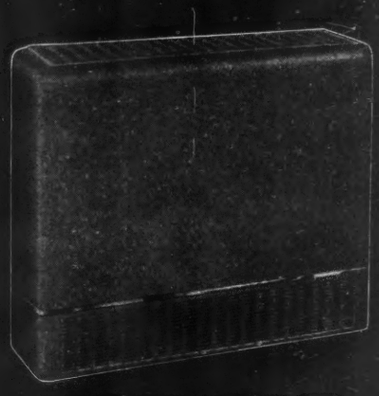


GAS FIRED UNIT HEATER



BLOWER TYPE UNIT HEATER (*FLOOR*)

DOWN FLOW UNIT HEATER



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examples show that the broad principles of motion economy can be applied to these other types of operations.

We have discussed in a general way the type of material to be included in a methods improvement training course, but no attempt has been made to outline specifically a complete series of meetings. Because of the variety of materials, processes, and operations, it is impossible to set up a single course of study that will apply universally in all plants or departments. However, considering motion economy broadly as the effective utilization of human energy, I believe that it is possible to modify the course material and adapt it to practically any type of plant.

Thus far we have considered the subject matter of the course but have overlooked certain organization details. About ten people to a class has proved to be a satisfactory number. A much larger group is awkward to handle and too small a group limits the discussion. Members of a class should be in the same type of work, and if possible from about the same level of authority.

It has been found that the best results are obtained with meetings from an hour to an hour and a half in length, and that the course should consist of from 12 to 16 weekly sessions. It is better to have the meetings and the course too short than to make them so long that interest lags. If the group wants more, the series can easily be extended. Registration should be voluntary, but should be definitely encouraged by the management and supervisors. The cost of the course should preferably be borne by the management, although in some plants where university extension classes have been held, members have paid from five to ten dollars registration fee. In one instance the management agreed to repay the fees of all who passed in the course. Whether the meetings are on company time or on the individual's own time makes little difference, but it is obviously important not to run into the hunting season or to hold meetings on bowling night.

It is highly desirable that classes be held in a laboratory or workroom where methods can be demonstrated and ideas tried out. An expenditure of $200 or $300 for equipping an experimental methods laboratory is a good investment. Such a laboratory permits the development of new methods without interfering with regular production, and also provides a good place to train operators in new methods without an audience of fellow workers.

Notes Summarize Meetings

At the beginning of each meeting, it is well to distribute brief notes of the preceding meeting. We have found that best results are obtained by omitting all material not directly applicable to the production problems of the particular group. There is a natural tendency to include too much material in order to make the notes academically complete, but this will defeat their purpose. If possible, the notes should be illustrated with sketches or photographs, and they should include: (1) descriptions of class problems that brought out certain principles, (2) a statement of the principles brought out in the problems, (3) an enumeration of other applications of these principles, and (4) a list of suggestions made during the meeting for the improvement of actual operations in the group's own plant.

In conducting the class, as much use as possible should be made of outside interests and talents of the members. The amateur photographer will be delighted to take pictures of old and new methods, and the home workshop enthusiast will gladly make special jigs and work station set-ups. I once had an aspiring artist in a motion economy class, and he did a fine job of illustrating our operation charts and instruction sheets.

In a group of supervisors, the im-

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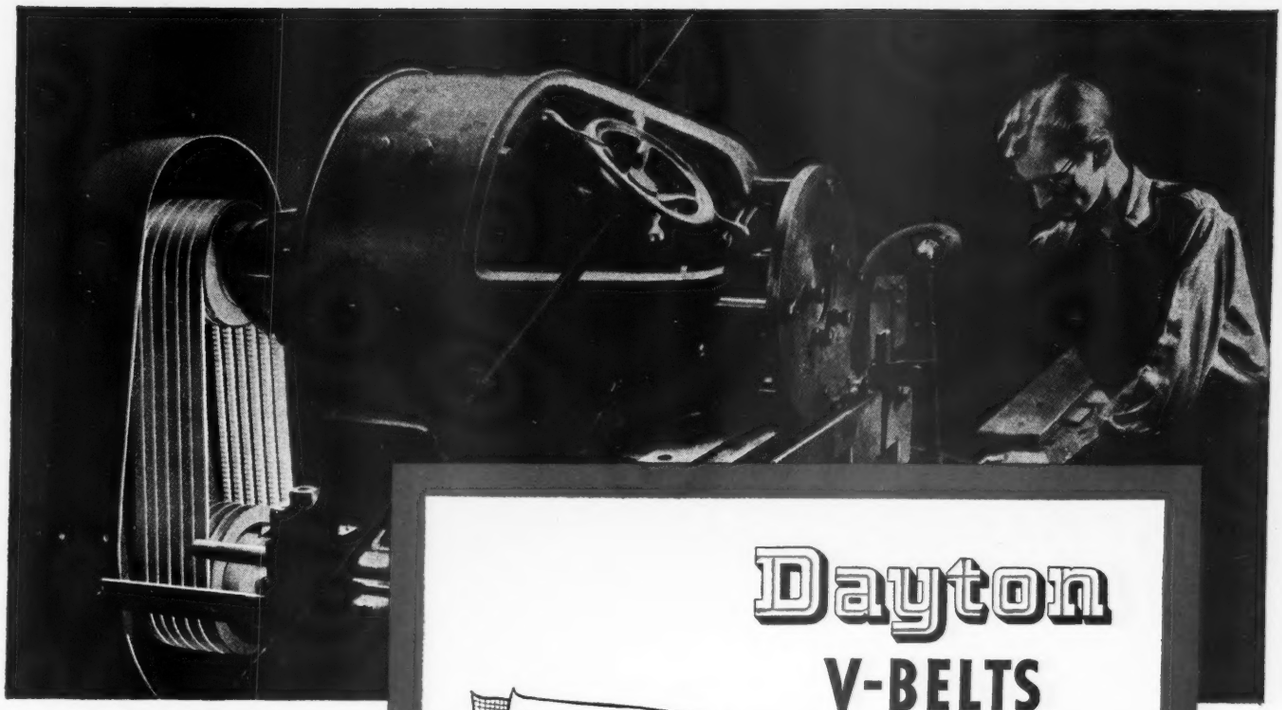

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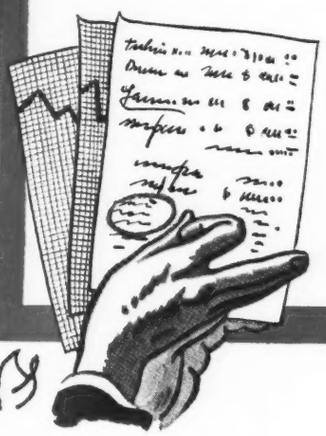

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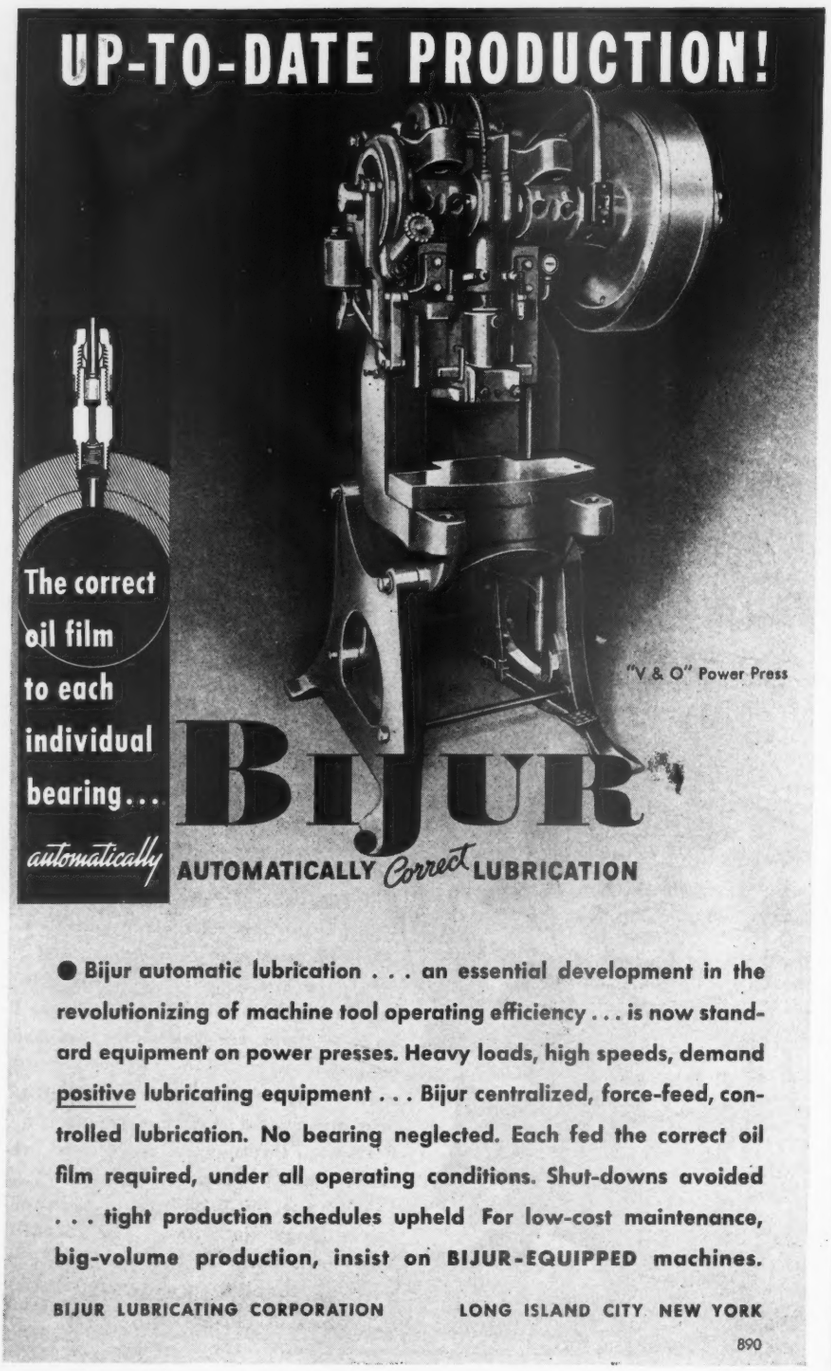
portance of passing the class material on to their men should be stressed. It is more credit to a supervisor to have a suggestion come from one of his crew than to have thought of the idea himself, for it indicates that he is doing a good job of directing and instructing his men. By this means benefits of the instruction will be extended and increased many times. I recall one foreman who over a short period of time showed me more than a dozen new ideas suggested by his crew of four men whose sole contact with motion economy was through the foreman himself.

If properly followed up and developed, suggestions received during the course should more than pay its cost. Then with active encouragement from the management, new ideas should be forthcoming for some time. Probably the most fundamental benefit from such a project is the fresh viewpoint it instills in the organization. This will key up the group and will help to take up a certain slack that sometimes develops in an organization after a period of routine operation. It also often proves stimulating to the management, since any outmoded or inefficient methods will be questioned rather than accepted by the operators and supervisors.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The correct oil film to each individual bearing... automatically
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BIJUR
AUTOMATICALLY Correct LUBRICATION
● Bijur automatic lubrication . . . an essential development in the revolutionizing of machine tool operating efficiency . . . is now standard equipment on power presses. Heavy loads, high speeds, demand positive lubricating equipment . . . Bijur centralized, force-feed, controlled lubrication. No bearing neglected. Each fed the correct oil film required, under all operating conditions. Shut-downs avoided . . . tight production schedules upheld For low-cost maintenance, big-volume production, insist on BIJUR-EQUIPPED machines.
BIJUR LUBRICATING CORPORATION LONG ISLAND CITY NEW YORK
890

Management Shorts

(Continued from page 68)

stockroom continuously, there was no possibility of moving the scale to the work place. This problem was solved in a very inexpensive way.

Since the parts were all uniform in size, standard containers that held exactly 500 pieces were designed and made up. Now, each time a container is full, the operator is credited with 500 pieces and the box is moved immediately to the next operation in the same room. After the second operation has been completed, that operator is credited with 500 and that very same container is used to transport the material up into the polishing room. After the polishing room has finished with the parts, they are placed in other containers and the counting containers are returned to the screw machine department.

●

Movement of Empty Tote Pans Schedules Production

E. H. Schaeffer, *Industrial Engineer*
J. E. Ogden Company
Bayonne, N. J.

By painting and stenciling on tote pans and hopper stacking bins the type and size of part for which each bin is to be used, it is possible to attain a paperless automatic control of work in process between two departments. The tins may be designed both to hold materials in storage and to serve as parts containers on the work table, thus saving the handling of materials into or out of containers when the materials are placed in or issued out of stores, and when moved on or off the work table.

Enough bins are marked for each type and size to hold a two days' supply of parts; each bin should be of such size that when full it contains a weight readily handled by one man. At the start, all bins are filled. At the end of each day, all bins emptied in department *B* are sent back to department *A*. These bins serve as a schedule for the following day's work in *A*. In operation, this control assures that each morning there will be at least a full day's supply of all parts in *B*.

If in department *B* only ten items are being used on a particular day, the bins emptied of these ten items will be the only ones returned at the end of the day to department *A* for refilling.

The second day's supply of parts remaining in *B* will allow operations to continue on these items during the next day, while the returned bins are being

"IT'S 9 TO 1 YOU'RE LOSING MONEY NOW"

Authorities agree that nine out of ten industrial plants in the country are in need of new wiring. Nine out of ten plants are losing money today through invisible power losses . . . power losses arising from antiquated, worn-out equipment, overloading or failure to provide adequate wiring for new equipment. Is your plant one of them?

Better check up now. Electrical failure . . . plant breakdown and consequent loss of output is even more expensive. Call in your maintenance man or electrical contractor and go over the problem of your plant's wiring Better yet, ask us to send you our Industrial Wiring Survey and Industrial Wiring Guide. The Survey will tell you how to check step-by-step—your electrical circuits; the Guide—what to do about the conditions you find.

Both are insurance against electrical failure . . . and whopping big repair bills. So, don't take chances . . . especially when those chances are 9 to 1 against you. Write for *free* copies of the Industrial Wiring Survey and the Industrial Wiring Guide now!

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from mine to consumer

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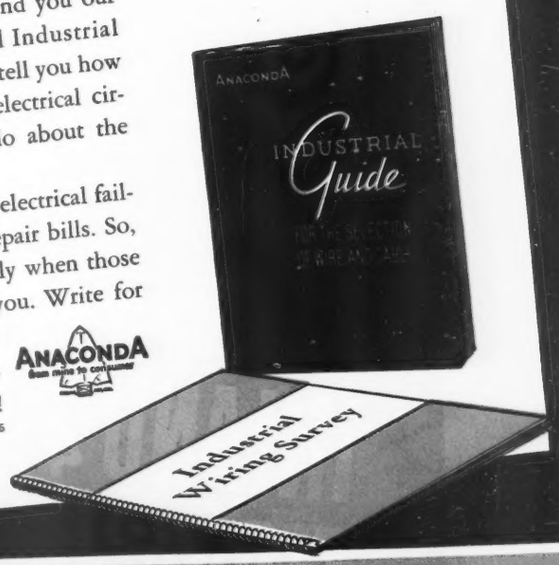

USE MODERN IMPROVED **Anaconda Wire & Cable**

ANACONDA WIRE & CABLE COMPANY, General Offices: 25 Broadway, New York City; Chicago Office: 20 North Wacker Drive

A Subsidiary of Anaconda Copper Mining Company. Sales Offices in Principal Cities

refilled. A full day is thus allowed for refilling bins in department *A*. Bins marked for and containing items not in use in department *B* will remain in *B* in storage. A two days' supply is the maximum quantity on hand in this department at any time.

Oversupply of one part and shortage of other parts are automatically prevented. Special conditions such as temporary increased production may be taken care of by special bins with removable cards which may be marked as required.

The foreman in department *A*, by observing the color paint or stencil on the bins on hand in his department, and the number of bins of each marking present, has an immediate, automatic schedule of his day's work, both as to which items to provide and quantity required.

While this system does not have universal application, it is quite useful in small parts manufacture in controlling material flow between plating room or storeroom and the next processing departments, especially in cases where a great variety of sizes and styles and a spasmodic demand prevent accurate scheduling by the more familiar methods of production control.

Here's a Tax You Can Cut
—the floor hazard tax
Unsafe floors are a source of occupational deaths and injuries for which American industry yearly pays staggering sums. There are claims paid, medical expense, the cost of insurance overhead, and the loss of investment in the time of skilled and specially trained workers.
These expenses are a tax against profits, but fortunately this tax can be materially reduced by making hazardous floors, platforms, runways and stair treads safer with Inland 4-Way Floor Plate. Whether wet or dry, Inland 4-Way Floor Plate gives full traction in all directions to feet and wheels. It drains readily and it is easily cleaned. Also, it is structurally strong, long wearing and fireproof. Write for the Inland 4-Way Floor Plate Catalog. It will show how you can reduce the floor hazard tax.
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INLAND 4-WAY
FLOOR PLATE

Production Control For a Job Shop

CALVIN R. LIBBY, *Minneapolis*

In a job shop, knowing how each of 200 or more different orders stands is quite perplexing. Here is a method of production control that seems to work.

The shop is divided into departments, each under a foreman and performing certain definite operations, as layout; cut, bevel, punch and roll; flange, rivet, bend and blacksmith; drill presses; machine shop; weld; assemble; test; inspect; paint.

Upon receipt of an order a stock man checks the bill of material and designates the source, as either coming from the stock or as being purchased. Copy of requisitioned material is attached to the order.

The order then passes to the estimator or process man who fills out a job record card. This card fits a Kardex file and contains spaces for drawing numbers, material, size, number of pieces, weight, cost per pound, size of welding rod, pounds of rod used, operations, allowable time, actual time, cost of labor only, customer's name, destination, description of order, scheduled completion date, order number, and remarks.

The order and job record cards are then passed to the scheduler who checks over the entire order and sets the completion date. Breakdown of machinery or a similar mishap will call for a revision of the entire schedule. The card is now placed on the planning board in file of the first department, or series of operations, through which order goes.

The planning board consists of a Kardex file—50 pockets for each department. These files are hung on the wall in a logical progression. Colored tabs are used to code information to the orders; *i.e.* green indicates lack of material, black indicates order is held up (reason can be penciled on card), blue designates a carload shipment, red shows order is in danger of falling behind schedule or is now behind schedule. The tabs are operated by the scheduler only.

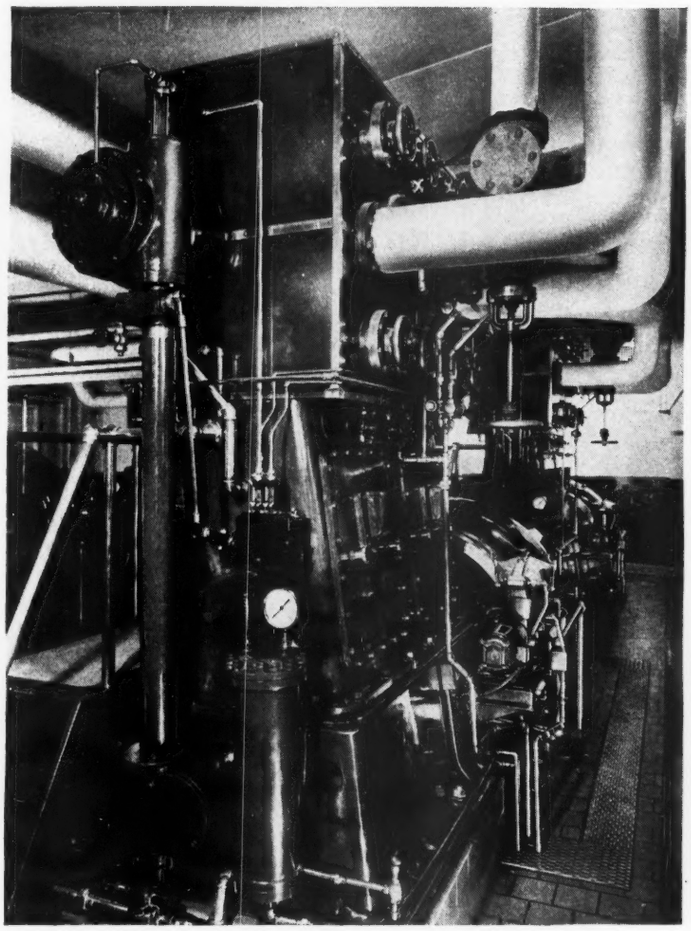
As each department finishes its operations, the foreman moves the card to the file of the next operation, and so on down the board until the finished material is in the shipping department and the card in the file of the shipping department. Cards with tabs are moved only by the scheduler.

The operators are punched in and out on each operation. Operation cards are kept in a rack in the planning department. This rack shows what each operator is doing and on which order he is working. This record per operation also shows who are the best operators.

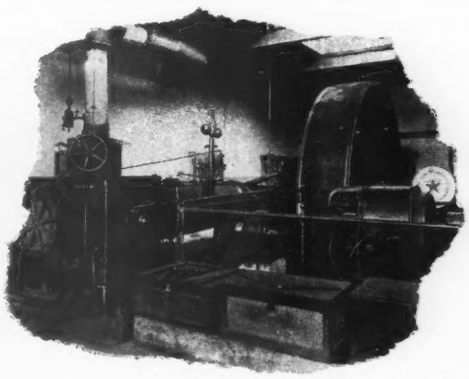
The actual time is posted on the job record card after the order is complete,

NEW or OLD

More Power with Less Steam



OPERATING 24 HOURS A DAY at 400 r.p.m. under 170 lbs. boiler pressure, this Ames Uniflow Engine maintains maximum efficiency year after year. Cylinders lubricated exclusively with *TEXACO 650T CYLINDER OIL*, cranks with *TEXACO REGAL OIL*.



Despite its ripe old age, this Corliss is still operating at low maintenance—thanks to *TEXACO PINNACLE CYLINDER OIL*.

WHETHER your engines are low-pressure veterans or modern super-heat jobs, you will get better steam economy when effective piston seal is maintained by correct cylinder lubrication.

The lubricants that are saving fuel and keeping down cylinder, ring, and valve wear for thousands of steam engine operators all over the world are *TEXACO STEAM CYLINDER OILS.*

There are fourteen *Texaco Steam Cylinder Oils* from which the proper oil can be chosen for every type of engine, every operating condition. The correct choice assures maximum economy in the operation of every type of engine.

Trained lubrication engineers will gladly cooperate in making savings with *Texaco Steam Cylinder Oils* in your engines. Just phone the nearest of more than 2300 Texaco warehousing points, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

Texaco Dealers invite you to tune in The Texaco Star Theatre—starring Kenny Baker and Frances Langford—Every Wednesday Night—Columbia Network—9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T

TEXACO

REG. T.M.

TEXACO Steam Cylinder Oils

or after each completed operation. This card is carefully checked, actual time against estimated, and filed for future use in estimating and planning.

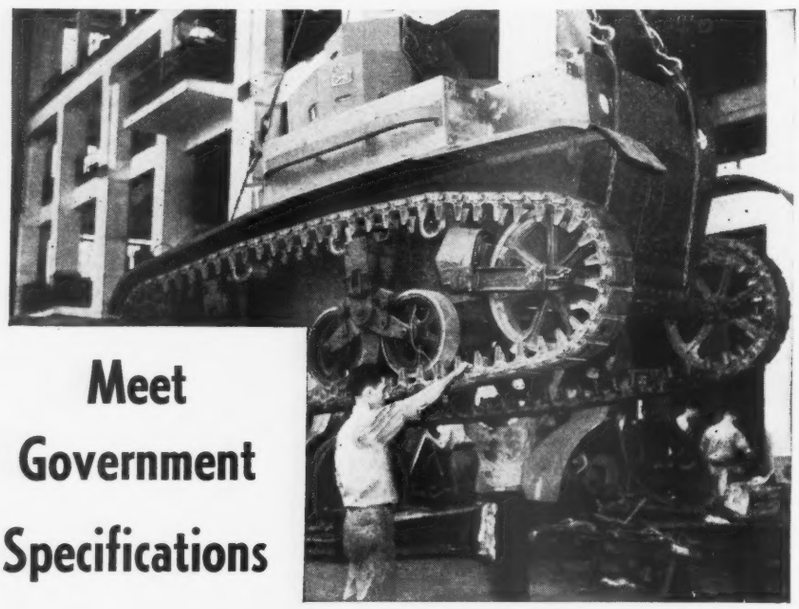
EMPLOYEE RELATIONS AND SAFETY

Toilet Paper Used To Prevent Accidents

NORMAN C. MULLER, *Oberlin, Ohio*

We keep a roll of toilet paper on the work bench and have found it to be useful in many ways. It is much cheaper than waste or rags for wiping off grease, oil, or dirt. It enables the workman to keep his hands and tools free of grease, thus eliminating the possibility of slipping or dropping tools into moving machinery. There is less danger of being caught in moving parts, because the toilet paper tears easily, while a rag or waste might draw a workman's hand into some moving part. In assembly, a person can easily tear off one or two sheets with one hand to wipe off a bearing or journal.

It is also very handy for cleaning goggle lenses.



Meet Government Specifications *with* RYERSON CERTIFIED STEELS

When you're working on orders for defense, government steel specifications are no problem . . . if you buy *Certified* Steel from Ryerson!

Under the Ryerson Certified plan, you get steels made to narrow, close-range specifications. You get accurately identified steel of known analysis . . . steel you can depend on to meet government requirements. It is also easier to pass inspection on the finished job if Ryerson Certified Steel is used. All Ryerson Steels are closely controlled as to chemical content, accuracy and finish without the slightest increase in cost to you. A special quality control plan on Alloy Steels assures uniform heat treatment response.

And deliveries are no problem if Ryerson is your source. Enormous stocks . . . over 10,000 kinds, shapes and sizes . . . in ten conveniently located warehouses, are ready for immediate shipment. Practically every order is on its way the day we get it. Get acquainted now with this worry-free, superior Steel-Service, if you are not already a Ryerson customer. Stock List and any special information sent promptly on request.

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Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

RYERSON CERTIFIED STEELS

RYERSON

Cater to Clock Watchers —Make Clocks Easy to See

E. F. SIBLEY
Chief Power Plant Engineer
Seamless Rubber Company, Inc.
New Haven, Conn.

Too little thought is given to locating clocks where they can be seen by the greatest number of workers, and where they can be seen without it being necessary for an operator to move from his or her customary working position.

Whether we approve of clock watchers or not we will always have a number of workers who when they cannot see a clock will make several trips just before noon and just before closing at night to determine the nearness of quitting time. Others may depend upon getting this information from workers more advantageously located, and will slow down or fail to start a new job unit that might run over the hour.

With a clock within the line of vision the worker will often "hop to it" and keep to a schedule that will let him finish on time with an extra unit of production to his credit. Time saved for an operator, resulting in larger pay, means a more satisfied worker and a lower employee turnover. More pieces or units per day per operator is also a real saving to the management, due to the reduction in overhead per unit. A little study will ordinarily indicate that extra clocks pay for themselves in a very short time.

•

Slogan Contest Teaches: "Do It for the Customer"

FRANK VOELKL
Superintendent, Pressroom
The Standard Register Company
Dayton, Ohio

We ran a campaign that we hoped would make everyone realize what a lost customer means to his job, to the company, and to the salesman.

We called it "Do It for the Customer" campaign. A slogan contest was used in which ballots with ten slogans, each emphasizing a different thought about the importance of keeping customers satisfied, were given to every employee, and prizes were given to those who graded all ten slogans nearest to the popular vote by all employees.

The slogans were arranged so that a complete story was read by the employee as he was grading them. Before he finally had all slogans graded, he had to read them over many times, and he was sure to have an increased appreciation of a satisfied customer. The three slogans receiving the largest popular vote were printed on cards

New Edition of the

BOOK OF FACTS IN FIGURES

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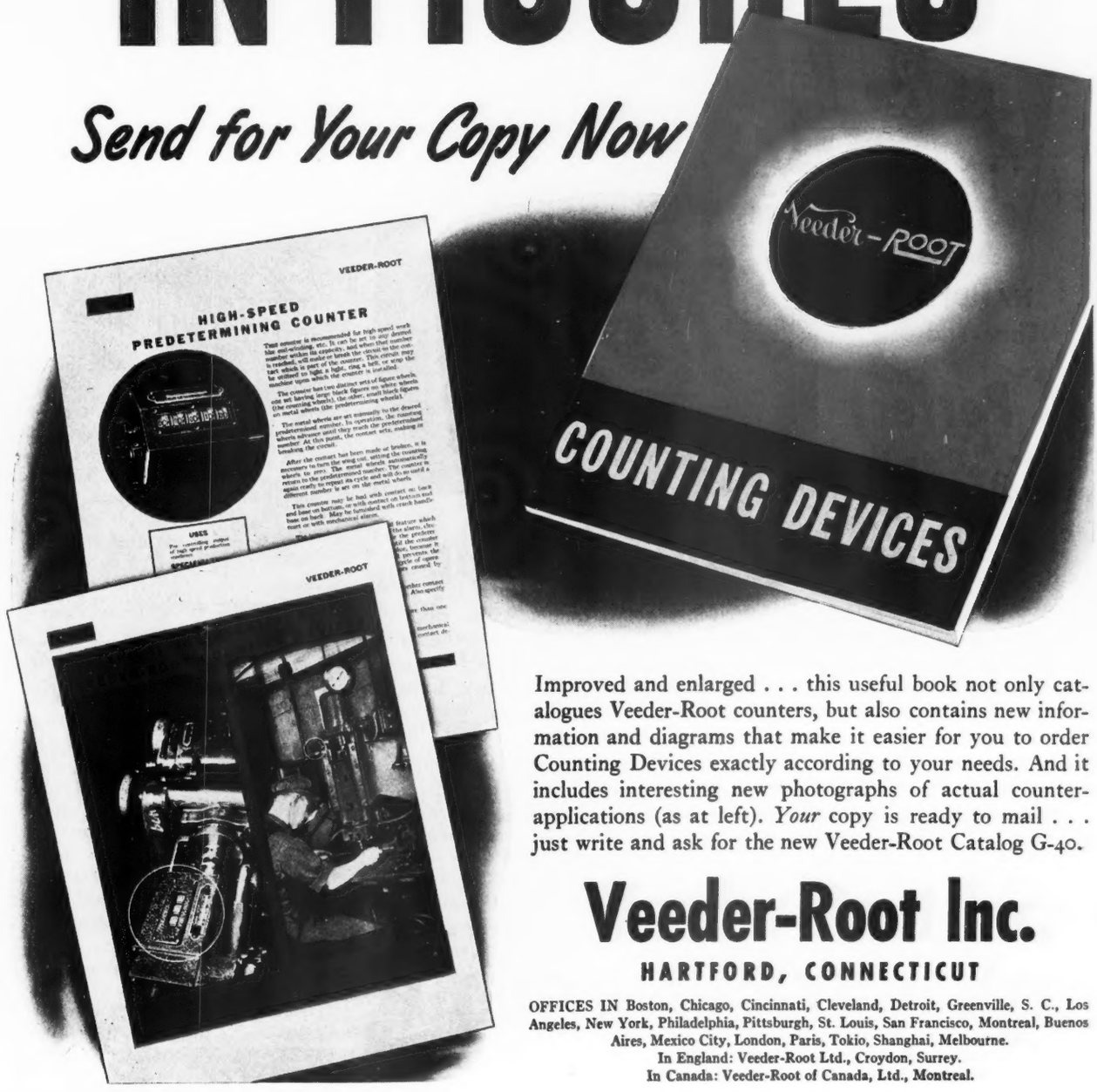

Improved and enlarged . . . this useful book not only catalogues Veeder-Root counters, but also contains new information and diagrams that make it easier for you to order Counting Devices exactly according to your needs. And it includes interesting new photographs of actual counter-applications (as at left). *Your* copy is ready to mail . . . just write and ask for the new Veeder-Root Catalog G-40.

Veeder-Root Inc.

HARTFORD, CONNECTICUT

OFFICES IN Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne.
In England: Veeder-Root Ltd., Croydon, Surrey.
In Canada: Veeder-Root of Canada, Ltd., Montreal.

and placed on every bulletin board and conveyor in the factory.

A good deal of interest was created by this contest. We had a 75 per cent participation in the voting, while in previous contests when employees were asked to write slogans we had less than 25 percent taking part. No political campaign results were ever argued any more than were the results of this contest. Many thought their choice of slogans was better and proceeded to tell why they thought so. All of this was extra thought that employees gave to the thing of which we wanted to make them conscious.

PRODUCTION METHODS AND MATERIALS

Cut Cost of Pyrometer Maintenance

SOURCE

Thwing-Albert Instrument Company
Philadelphia

Cost of maintaining the temperature measuring equipment used by an Eastern plant in its high-speed steel heat-treating department was considered so high that steps were taken to reduce it. Study of the problem led to the installation of an indicating radiation pyrometer system of temperature measurement.

A wall-type indicating pyrometer, calibrated with a temperature range up to 2500 degrees Fahrenheit, is mounted on a panel at the furnace. The radiation receiving tube is mounted at the side of the furnace and sighted through a hole in the furnace wall directly at the material that is being heat-treated. The radiation receiving tube is housed in a case made of heat-resistant material to protect it in the event that back pressure causes flame to issue from the hole in the furnace wall.

This installation has given several years' service without requiring any attention.

•

Cuts Cost of Grinding Cemented Carbide Tools

SOURCE

Norton Company
Worcester, Mass.

Recent tests at the plant of a leading aircraft manufacturer showed metal-bonded diamond wheels to have ten times the life of a similarly shaped resinoid-bonded product. Wheels were in 24-hour service in the grinding of cemented-carbide tools. Operators complained that rounded corners and grooves appeared quickly on the resinoid wheel due to continued application of narrow contact work and sharp angle-forming tools.

This condition, of course, made the accurate grinding of carbide-tipped tools difficult. Metal-bonded diamond wheels, now adopted as standard equipment, show no tendency toward grooving or wearing at the corners. Over 2,000 tools have been ground to date with less than 0.004-inch reduction in the thickness of the diamond layer.

•

Die-Casting to Save 45%

SOURCE

Havrill Aircraft Die Casting Corporation, Los Angeles

Thread protectors made and used by a manufacturer of oil field tools and equipment were originally fabricated from pipe stock. Caps were welded in place, the male and female threads on the two parts were machined.

All this was satisfactory from a use standpoint, but the product lent itself neither to high production schedules nor low costs. Also, it somehow didn't look the part.

Solution of the problem lay in die-casting the entire assembly. This method has increased daily production capacity five times over the old method, and at the same time has effected a saving of 45.3 percent.

HANDLE IT
"Thru-The-Air"

A Perfect Set-Up for "Pouring On The Welds"

The welders really "pour 'em on" at this tractor plant. Here's how they do it: Heavy tractor parts come down the line "thru-the-air" on P&H Hevi-Lift Hoists. At selected points the parts are lowered and clamped into jigs. Then, as the welders go to work, hoists tip the jigs, positioning the parts for speedy production.

Result: *this manufacturer is able to keep things moving faster at a lower cost.*

You may not make tractors, but the chances are you can cut your handling costs, as countless others have done, wih P&H Hevi-Lift Hoists. A P&H hoist engineer will gladly consult with you, without obligation.

WRITE FOR BULLETIN H-5

General Offices: 4525 W. National Avenue, Milwaukee, Wisconsin

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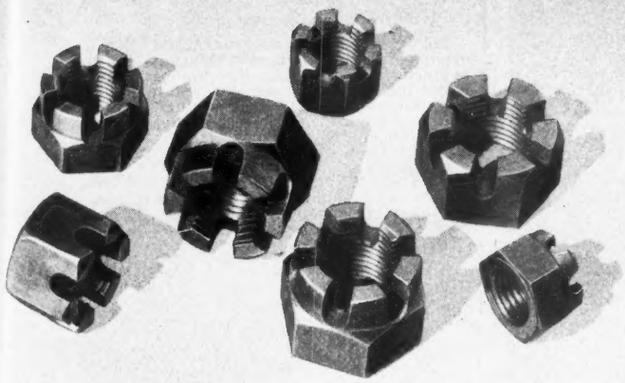
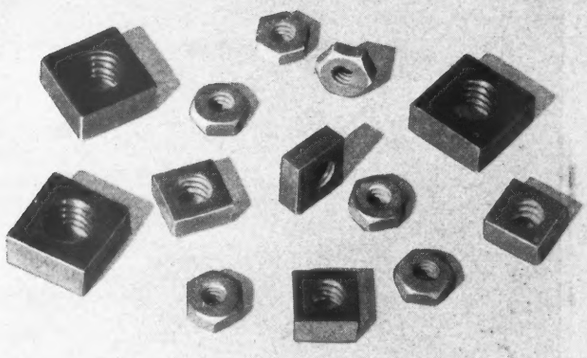
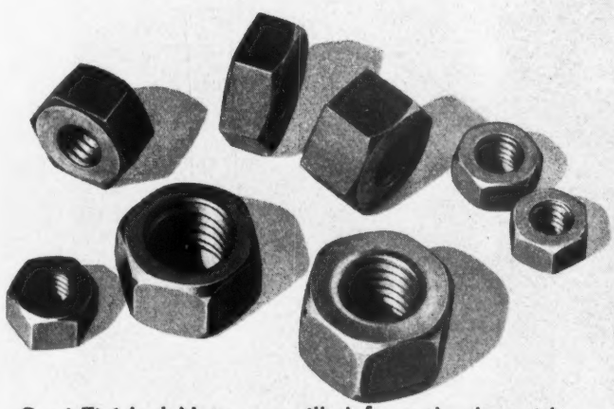
EVERY KIND OF *Nut* IN QUANTITY—QUICKLY



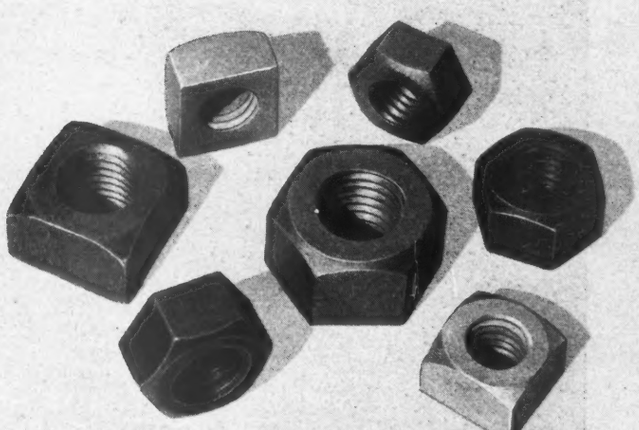
Castle and Slotted Nuts are milled from selected bar stock and conform to Bolt and Nut Institute standards. Stocked in a full range of sizes. Like Semi-Finished Nuts they can be furnished in non-ferrous alloys to your specifications *in production quantities.*



Machine Screw and Stove Bolt Nuts are made in plain square and chamfered hexagon types by cold punching from flat bar stock. Square nuts of this type are generally supplied with Stove Bolts.



Semi-Finished Nuts are milled from the bar with washer face, or cold forged with double chamfer, both conforming to identical dimensions. Cold Forged Nuts upset from round wire combine the accuracy and finish of nuts milled from the bar with the added toughness of the cold punched nut.



Hot Pressed Nuts are punched from hot rolled low or medium carbon steel bars at forging temperature, then cooled, burred and tapped. Cold Punched Nuts which have a bright surface are more accurately made than the Hot Pressed Nuts which have a black oxide coating, mildly rust resistant.

● So many types of nuts are standardized today that it is seldom necessary to specify a nut "made to order." All nuts shown above are typical of *standard types in stock.* Four classifications are used in manufacturing practice, and these are as follows. (1) American Standard regular, heavy, light, machine screw and stove bolt, according to *dimensional proportions.* (2) Unfinished and semi-finished, according to *the degree of their finish.* (3) Hot pressed, cold punched, cold forged and milled from the bar, according to *method of their manufacture.* (4) Full, jam, slotted and castle nuts, *according to styles.* For additional information write us for folder entitled "Types of Common Nuts and Their Selection" or ask a Lamson representative to call. Nuts of ferrous and non-ferrous alloys made to specifications in production quantities.

●

THE LAMSON & SESSIONS CO., Cleveland, Ohio

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Your Jobber stocks the Lamson Line

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BOLTS • • NUTS • • COTTERS • • CAP SCREWS • • SPECIALS

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COLLOIDAL GRAPHITE
SURVIVES FIRE . . .
. . . without losing its lubricating properties even at temperatures of 1800°F and upwards in ceramic and glass making machines; in conveyors and baking ovens, in die casting and permanent mold equipment.
"Dag" outlasts temperatures that burn petroleum oil, thus lubricants can be prepared by dispersing this product in fluids that quickly evaporate at the higher temperatures. Only a positive, clean lubricating film of pure "dag" colloidal graphite is left which becomes affixed to the bearing surfaces. "Dag" makes an ideal teammate for oil, as it takes over the load at the point beyond which plain lubricants fail.
A note on your letterhead will bring a production sample and Technical Bulletin 130 which tells how to use "dag" for high temperatures . . . you or your oil supplier can easily add "dag" to your present lube or to specially selected petroleum fluids.
ACHESON COLLOIDS CORPORATION
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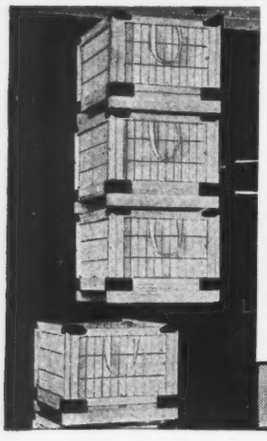
COLLOIDAL PRODUCTS

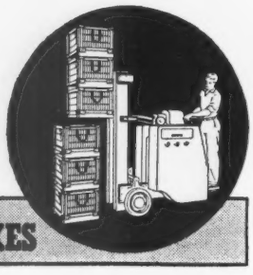


. . . with the GREATEST of EASE

More and more, small as well as large industrial plants are using Lewis Skid Boxes with the new low priced power lift trucks now available. They make combinations that lower material handling costs wherever they are installed!

Strong, durable and light weight, these long lived, low cost boxes give you space-saving uniformity and "stackability". They can be tailor made to fit your product — ask about our 30 day free trial.

G. B. LEWIS CO.
Dept. N9, Watertown, Wisconsin



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BOOKS

OUTLINE OF INDUSTRIAL RELATIONS POLICIES IN DEFENSE INDUSTRIES

Industrial Relations Section, Department of Economics and Social Institutions, Princeton University, Princeton, N. J. 47 pages, bibliography. 75c.

Survey concentrates on three major groups of industries: Aviation—parts, engines, planes, and instruments; machine tools; basic mass production industries including steel, steel products, chemicals, electrical machinery, and transportation equipment. Main topics include expansion of management organization, recruitment of production workers, training of skilled and semi-skilled workers, wages and hours of work, employee-management cooperation in accelerated production.

VARIABLE BUDGET CONTROL

Fred V. Gardner, Industrial Management Consultant. McGraw-Hill Book Co., Inc., 330 West 42d St., New York. 357 pages, charts, graphs, schedules, tables, index. $4.

What variable budget control is; what its advantages over static budgeting are; how to develop, install, and administer it are questions considered by the author in his attempt to aid management in the control of costs and the correction of those conditions that may lead to unnecessary losses. Treatment of the development of controls, the adjustment of costs to current operations, the maintenance of a profitable balance between them and quality and quantity of output places the emphasis on what is happening in a business rather than on what has happened.

GOVERNMENT AND ECONOMIC LIFE

Leverett S. Lyon, Victor Abramson and Associates, The Institute of Economics of The Brookings Institution. The Brookings Institution, Washington, D. C. 1301 pages, index. $3.50.

Volume II, an interpretation of American public policy in relation to our economic life. Whereas Volume I dealt with governmental implementation and regulation of private enterprise as it has been applied generally to a wide range of industrial and commercial life, Volume II goes on to discuss it in relation to limited areas of economic life. Treatment of private enterprise comes under two heads: The special treatment of a number of individual industries—foreign commerce, public utilities, petroleum and natural gas, transportation; the exercise of special controls on certain specific occasions—the N.R.A., war. Direct production by government, and government as an organizer and an administrator of public relief and social security are also discussed.

BUSINESS MANAGEMENT AND CHARACTER

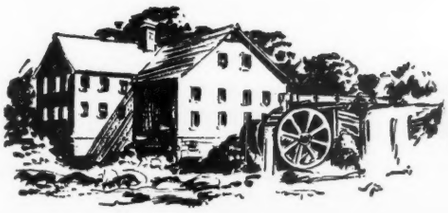
Roger W. Babson, Chairman, The Babson Statistical Organization; T. H. Schutte, Head of the Department of Education and Director of Professional Work, New Mexico State Teachers College. The Christopher Publishing House, 1140 Columbus Ave., Boston. 63 pages, $1.

In Part I Mr. Babson stresses the importance to the individual and the nation of building all business and industrial relationships on a thoroughly Christian foundation. He says, "National business is the builder or the destroyer of national character." The contribution to character through management — religious, educational, industrial and other institutions is discussed in Part II by Mr. Schutte. Pointers on how to keep smooth the employer-employee relationship are outlined.

MOTION AND TIME STUDY

Ralph M. Barnes, Professor of Industrial Engineering and Director of Personnel, College of Engineering, University of Iowa. John Wiley & Sons, Inc., 440 Fourth Ave., New York. 390 pages, illustrations, tables, diagram. $3.75.

Second Edition. Amplifies material on process charts, operation analysis, visual direction through introduction of case material showing diverse applications. Section on stop-watch time study has been enlarged, two chapters have been added to illustrate use of time values for combinations of therbligs in setting time



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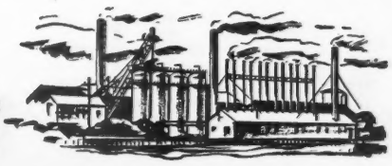

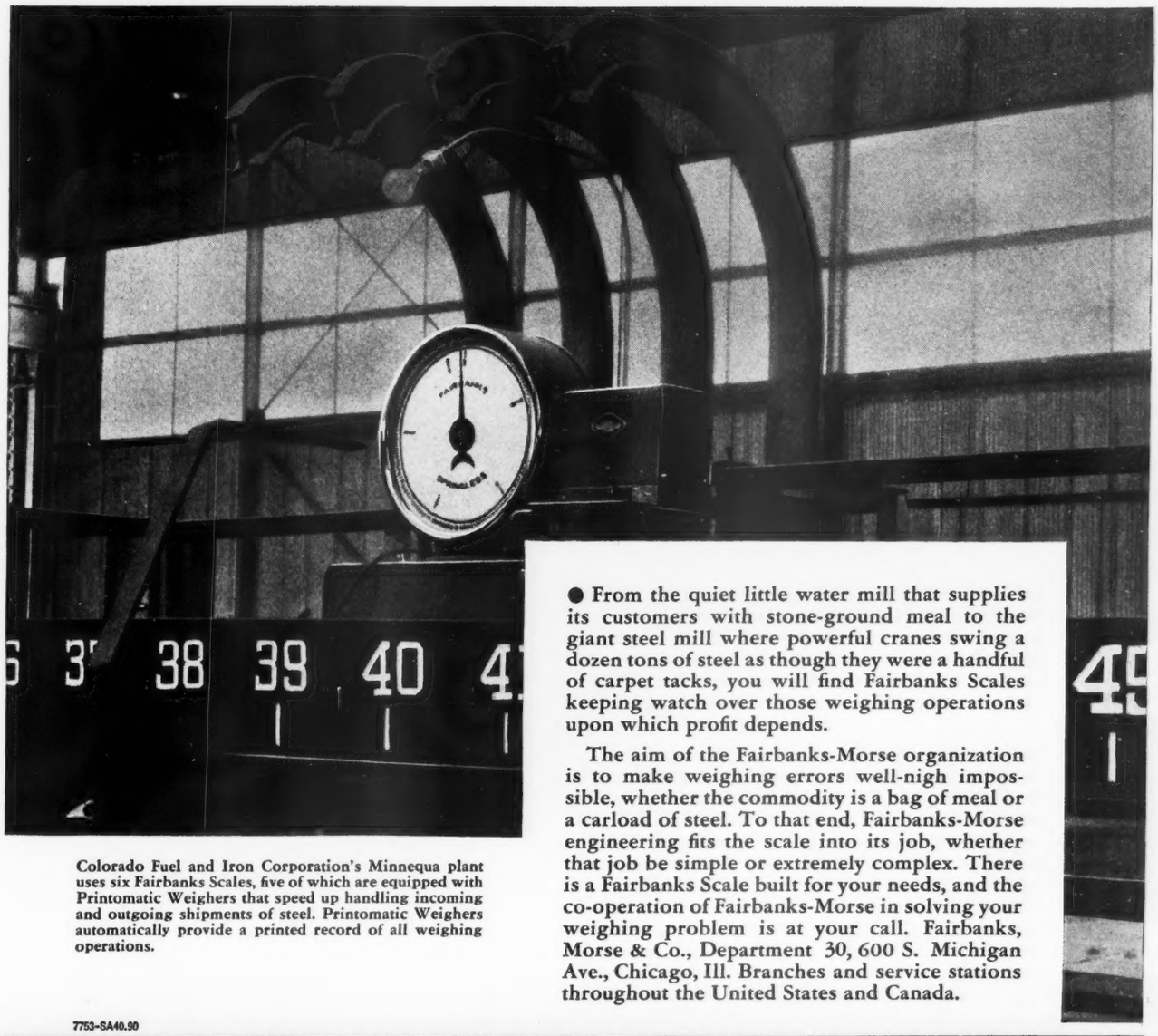

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MODERN EXPORT PACKING—1940

Joseph Leeming, Transportation Division, Department of Commerce. Superintendent of Documents, Government Printing Office, Washington, D. C. 530 pages, illustrated. $1.

Discussion of the principles of export packing covers the various methods used; takes into consideration the more important factors influencing the type of packing to be used—loading and unloading facilities, climatic conditions, foreign regulations; and outlines conditions and facilities at ports throughout the world. Construction of boxes and crates is given considerable space.

PROCEEDINGS OF THE 1940 LOUISIANA PERSONNEL CONFERENCE

Sponsored by The College of Commerce, Louisiana State University, University, La. 55 pages. 35c.

Held at Louisiana State University, May, 1940. Object of the conference was to advance analysis of problems of policy and operation of particular concern to business and industrial leaders in Louisiana. Speeches and discussions included in the booklet come under the headings: Meeting the Worker's Risks, Employment Techniques, Governmental Round Table.

LESSONS IN ARC WELDING

The Lincoln Electric Company, 12818 Coit Road, Cleveland. 136 pages, drawings, photographs. 50c postpaid in U. S. A., 75c elsewhere.

For beginners and experienced welders, supervisors, foremen, instructors seeking data on arc welding and a guide to its proper application. Its fifty-one lessons appear in four sections: Nineteen in Welding With Unshielded Arc Electrodes, nine in Welding With Shielded Arc Electrodes, fifteen in Electrodes for Particular Joints and Metals, eight in Hardfacing. Two sections in the back contain questions and answers on each of the lessons.

ADDRESSES ON INDUSTRIAL RELATIONS—1940

Bureau of Industrial Relations, University of Michigan, Ann Arbor, Mich. 121 pages, mimeographed. $1.

Held in April, 1940. Addresses included discuss policies in view of recent developments, consider labor legislation and its effects, review methods whereby relations between individual companies and employees have been improved.

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ON THE CALENDAR

SEPTEMBER

3–6, American Society of Mechanical Engineers, Fall Meeting, Spokane, Washington. C. E. Davies, Secretary, 29 West 39th St., New York.

18–20, National Industrial Advertisers Association, Annual Meeting, Detroit. Miss M. R. Webster, Headquarters Secretary, 100 East Ohio St., Chicago.

OCTOBER

7–11, National Safety Council, Annual Meeting, Chicago. W. H. Cameron, Managing Director and Secretary, 20 North Wacker Drive, Chicago.

16–18, Porcelain Enamel Institute, Fifth Annual Forum, University of Illinois, Urbana, Ill. C. S. Pearce, Secretary, 612 North Michigan Ave., Chicago.

20–25, American Welding Society, Annual Meeting, Cleveland. Miss M. M. Kelly, Secretary, 807 Riverside Drive, New York.

27–Nov. 1, National Electrical Manufacturers Association, Annual Meeting, New York. W. J. Donald, Managing Director, 155 East 44th St., New York.

NOVEMBER

8–9, National Time and Motion Study Clinic, Third Meeting, Chicago. W. F. Entorf, Publicity Chairman, Industrial Management Society, 421 Engineering Building, 205 West Wacker Drive, Chicago.